

P.O.Y-590406

MODEL 9514 CONTROLLER

and

MODEL 9515 OSCILLATOR

MODELS 9514A/AS and 9515A/AS

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INSTRUCTION MANUAL

MODEL 9514 CONTROLLER

and

MODEL 9515 OSCILLATOR

MODELS 9514A/AS and 9515A/AS

**PRELIMINARY
MANUAL**

SINGER
INSTRUMENTATION

The Singer Company, Palo Alto Operation

3176 Porter Drive, Palo Alto, California 94304/ (415) 493-3231 TWX 910-373-1765

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- | | |
|--|--|
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| 2. Serial Number | 6. Has maintenance action been previously requested? |
| 3. Approximate date instrument was placed in operation | 7. Other comments |
| 4. Approximate number of hours of use | |

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- (2) Include data on symptoms, measurements taken, test instruments used, suspected location of trouble, maintenance action taken, and any other relevant data.

TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
I	GENERAL INFORMATION	1-1
	1-1 Model 6600 Series Sweep Oscillator	1-1
	1-3 General Description	1-1
	1-4 Sweep Modes	1-1
	1-6 Output Signals	1-2
	1-8 Modulation	1-2
	1-10 The 9514 Controller and 9515 Oscillator Units	1-2
	1-12 Applications	1-2
	1-14 Specifications	1-3
II	OPERATION	2-1
	2-1 Receiving Inspection	2-1
	2-5 Preliminary Inspections	2-1
	2-7 Power Requirements	2-3
	2-10 Chassis Grounding	2-3
	2-12 Cooling	2-4
	2-14 Removing and Installing the 9514 Controller	2-4
	2-17 Frequency Dial Installation	2-4
	2-19 Frequency Dial Position Calibration	2-5
	2-21 Controls, Indicators, and Connectors	2-5
	2-23 Operating Instructions for the 9514/9515 System	2-11
	2-29 ΔF Narrow Band Sweep	2-13
	2-31 Other Modes of Operation	2-14
	2-33 Other Control Functions	2-14
	2-35 Operating Instructions for the 9514 Controller and 9515 Oscillator	2-14
	2-36 Minimum Performance Standards Test Procedure	2-15
III	THEORY OF OPERATION	3-1
	3-1 General Function of 9514/9515	3-1
IV	MAINTENANCE	4-1
	4-1 General	4-1
	4-3 Packaging for Shipment	4-1
	4-5 Troubleshooting, General	4-1
	4-7 Power Supply, A1	4-9
	4-9 Regulator #1 Board, A13	4-9
	4-11 +20V Regulator	4-9
	4-15 -20V Regulator	4-10
	4-19 +5 Volt Regulator	4-10
	4-23 -11 Volt Regulator	4-11
	4-27 +1.0 Volt Regulator	4-11

TABLE OF CONTENTS

(Continued)

<u>Section</u>		<u>Page</u>
IV	MAINTENANCE (Cont.)	
4-30	Regulator #2 Board, A12	4-11
4-32	+10.5 V Regulator	4-14
4-36	-10.5 V Regulator	4-14
4-40	- Program Voltage Regulator	4-14
4-44	+5 Volt Floating Regulator	4-15
4-46	Tuning Ramp and VPF Ramp Circuits, A5	4-15
4-53	Bandswitch Logic, A6	4-20
4-76	Frequency Modulation, A2	4-26
4-82	VCO Driver, A9	4-31
4-93	YIG Drivers, A8, A10, A11	4-35
4-105	9514 Controller	4-48
4-118	Leveling Circuit, A4	4-56
4-129	Pulse Modulation Circuit A3	4-62
4-135	Returning the Instrument	4-83

LIST OF ILLUSTRATIONS

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
2-1	Model 9514 Controller Front Panel Controls, Switches and Indicators	2-6
2-2	Model 9515 Oscillator Front Panel Controls, Switches and Connectors	2-8
2-3	Model 9514/9515 Rear Panel Connectors	2-10
3-1	9514 Block Diagram	3-3
3-2	9515 Block Diagram	3-4

LIST OF TABLES

<u>Table No.</u>	<u>Title</u>	<u>Page</u>
1-1	Specifications for the 6600 Main Frame	1-4
1-2	Options	1-7
1-3	Specifications for 9514/9515 System	1-8
2-1	Preliminary Inspection Checks	2-2
2-2	Model 9514 Controller Front Panel Controls, Switches and Indicators	2-7
2-3	Model 9515 Oscillator Front Panel Controls, Switches and Connectors	2-9
2-4	Model 9514/9515 Rear Panel Connectors	2-10
2-5	Recommended Test Equipment for 6600-9514-9515 Sweep Systems	2-16
2-6	Minimum Performance Standards Test Procedures	2-17
2-7	Calibration Chart for Model 9515	2-20

TABLE OF CONTENTS
(Continued)

<u>Table No.</u>	<u>LIST OF TABLES</u>	<u>Page</u>
4-1	No Lights, No RF Power	4-3
4-2	No RF Power, Panel Lights Operate	4-4
4-3	Improper Output Frequencies	4-18
4-4	Logic Element Conditions for Band 7 in Driver Circuit for 2 Millisecond One Shot	4-27
4-5	Improper Frequency Modulation	4-30
4-6	No Sweep of RF	4-46
4-7	Improper VPF Out	4-52
4-8	RF Output is Not Leveled	4-53
4-9	AM Not Proper	4-55
4-10	Pulse Modulation, RF or Video Out is Improper	4-61
4-11	Alignment Procedure 9515	4-66

SECTION I

GENERAL INFORMATION

1-1 MODEL 6600 SERIES SWEEP OSCILLATOR

1-2 The Model 6600 operates as a wide band sweep oscillator when combined with the 9514 Controller and 9515 Oscillator. The swept frequency output is a linear function of time, and both sweep width and sweep rate can be independently adjusted. In addition to swept RF, the instrument also operates as a single-frequency signal source, tunable anywhere in its frequency range, with stability rivaling that of mechanically-tuned signal generators. The 9514 and 9515 units cover the frequency range from .1 GHz to 18 GHz. The 9514/9515 are supplied with a linearly-calibrated frequency dial that is attached to the panel of the Model 6600.

1-3 GENERAL DESCRIPTION

1-4 SWEEP MODES

1-5 The Model 6600 has three sweep modes, three markers, internal and external modulation and leveling capabilities, display outputs, and other features. There are three electronically controlled automatic sweeps (full band, narrow-band symmetrical sweep, and marker sweep), and a manual sweep mode. The full band sweep covers the full frequency range. During narrow-band symmetrical sweep (ΔF) operation, the frequency can be swept up to $\pm 10\%$ of the full frequency range, about any desired center point (F_o). Marker Sweep covers frequencies between Markers M1 and M2. All sweeps can be either free-running or triggered automatically by the ac power line, an external trigger source, or a manual trigger. Sweep times are variable from 0.01 to 100 seconds. During Manual Sweep, the frequency can be manually tuned over the full range of the instrument or between preset marker frequencies. Three

frequency markers are available in full band mode and two in ΔF mode. Markers appear as RF pips at the frequency selected. Video pulse markers are available at the MARKER connector for combination with the RF detector output display.

1-6 OUTPUT SIGNALS

1-7 Several voltages are available for oscilloscope and recorder control. For X-axis deflection of oscilloscopes and recorders a +10 V sweep voltage coincident with the RF sweep is available. A +10 V blanking pulse is available during retrace. Also during retrace, for sweep times greater than one second, a relay with isolated S.P.D.T. contacts may be used to operate a recorder pen lift. The RF output may be either left on or turned off automatically during retrace.

1-8 MODULATION

1-9 The RF output may be amplitude-modulated by either an external signal or an internally generated square wave. The square wave frequency is continuously adjustable from 950 to 1050 Hz. There are also provisions for external frequency modulation. The RF output may be leveled across all or any portion of the band.

1-10 THE 9514 CONTROLLER AND 9515 OSCILLATOR UNITS

1-11 The Model 6600 is the main chassis, which contains the power supply, frequency control, modulation circuits, and an opening for the 9514 Controller. The 9515 unit contains the RF components and an auxiliary power supply.

1-12 APPLICATIONS

1-13 By offering both swept-frequency and stable fixed-frequency output, with many

modulations and control options, the Model 6600 fulfills practically all requirements for microwave signal generation. It can be used to drive advanced swept-frequency test setups or for precision single-frequency tests. It can be amplitude-modulated, pulse-modulated, frequency-modulated, and remote-programmed to meet special system requirements. Detailed operating instructions for use of the instrument in its various operating modes are given in Section 3.

1-14. SPECIFICATIONS

1-15. Specifications for the Model 9514/9515 system are shown in Table 1-1.

TABLE 1-1

SPECIFICATIONS FOR THE 6600 MAIN FRAME

SWEEP AND SINGLE FREQUENCY CHARACTERISTICS

Full Band Sweep:	Sweeps across full frequency range of 9515, as controlled by the 9514.
Frequency Accuracy:	See 9515 specifications, Table 1-3.
Marker Sweep:	Sweeps from M1 to M2 up or down in frequency. Continuously adjustable to any combination of start and stop frequencies.
Accuracy:	See 9514/9515 specifications, Table 1-3.
ΔF Symmetrical Sweep:	Sweeps upward in frequency about center frequency, F_o . Sweep width continuously adjustable on scale calibrated in MHz from 0 to 20% of frequency range.
ΔF Width Accuracy:	$\pm 0.5\%$ of F_o .
Manual Sweep:	Adjusts frequency of output between sweep limits of full band, Marker, or ΔF sweep modes.
Sweep Time:	Continuously variable from 0.01 to 100 seconds per sweep in four ranges.
<u>Sweep Triggering Modes</u>	
Internal:	Internally-triggered recurring sweep.
Line:	Recurring sweep synchronized with line frequency.
External:	External +5 V trigger, with 2 msec or less rise time, activates sweep.
Single:	Pushbutton activates single sweep. Second depression returns sweep to start on 10 second range. Externally applied ground contact stops and holds sweep.
Sweep Voltage:	DC-coupled sawtooth varying from 0 volts at start to +10 volts at end of sweep, regardless of sweep mode, width, or direction. In CW mode, voltage varies from 0 to +10 volts in proportion to F_o frequency setting.

TABLE 1-1, Continued

Voltage Proportional to Frequency:	DC-coupled 0 to +10 V sawtooth beginning and ending at voltages proportional to start and stop frequencies.
Retrace RF Blanking:	Output power turned off. RF turned on prior to start of sweep to allow stabilization of external equipment.
Blanking Pulse:	+10 V during retrace.
Pen Lift:	Relay contact open or closed during retrace.
CW Frequency Vernier:	F_o fine tuning up to $\pm 2\%$ minimum with F_o FINE; calibrated in MHz by depressing CW FINE.
Accuracy:	$\pm 2\%$ of maximum F_o Fine.
Spurious Signals:	See 9515 specifications.
Residual AM:	>50 dB below signal in 150 kHz bandwidth at rated leveled power.
Stability:	With temperature: $\pm 0.03\%/^{\circ}\text{C}$. With 10% change in line voltage: $\pm 0.0002\%$. With change in output level: See plug-in specifications.

MARKER CHARACTERISTICS

M1, M2, F_o Markers:	<u>Sweep Mode</u>	<u>Available Markers</u>
	Fullband ΔF or F_o $M1 \rightarrow M2$	F_o , M1, M2 M1, M2 F_o
	Markers available as pip in RF and as sharp video triangle from front panel connector. Width varies with amplitude down to zero.	
Accuracy	$\pm 1\%$ of Dial Frequency	
Video Marker Amplitude:	0 to -5 volts. $Z = 1000$ ohms	

TABLE 1-1, Continued

LEVELING CHARACTERISTICS: See 9515 specifications.

MODULATION CHARACTERISTICS

Internal Square Wave:	Continuously adjustable 950-1050 Hz. Rise time typically 50 μ sec. (Rear panel)
On/Off Ratio:	See 9515 PM specifications.
External AM:	See 9515 specifications.
External FM:	
Frequency Response:	DC to 100 Hz for full band deviation (see 9515 specifications).
Modulation Sensitivity:	+10 volts or 1 k Ω potentiometer for full band deviation. Positive-going voltage increases frequency.

OTHER CHARACTERISTICS

Remote Digital Programming: 5 volt logic TTL and RTL or contact closures. See Option 5.

Accessories Furnished: 7-1/2 foot power cord with NEMA plug.

Rack mounting kit

Instruction Manual

Tilt Bail

Dimensions:	Overall Depth:	15-3/4"
	Depth Behind Panel:	15"
	Width:	16-3/4"
	Height:	5-1/4"

Weight: Approximately 35 lbs. Main Frame only.

Power: 115 or 230 volts $\pm$ 10%, 50/60 Hz; approximately 30 watts.

TABLE 1-2

OPTIONS

Option 1:	Side panel carrying handle.
Option 2:	Operation from 380-420 Hz power source.
Option 5:	Remote digital programming, TTL Compatible
Enable:	1 line binary.
Band Selection:	4 line binary.
Frequency Select:	12 line binary (1000 discrete frequencies), BCD.
Enable Internal Square Wave:	1 line binary.

TABLE I - 3

SPECIFICATIONS FOR 9514A/9515A SYSTEM

	"A" Version	"AS" Version
Frequency Range: Band	1. .1 - 2 GHz 2. 2 - 8 GHz 3. 4 - 12 GHz 4. 8 - 18 GHz 5. 2 - 18 GHz 6.	OR 1. .1 - 2 GHz 2 - 4 GHz 4 - 8 GHz 8 - 12.4 GHz 12.4 - 18 GHz 2 - 18 GHz
Frequency Accuracy:	$\pm 1\%$ plus ± 10 MHz, of indicated frequency Band 1. $\pm 1\%$ of indicated frequency in swept or CW mode in Bands 2, 3, 4; $\pm 2\%$ in 2 - 18 range. Band 5.	
FM:	.1 - 2 GHz: <12 kHz peak 2 - 4 GHz: <10 kHz peak 4 - 8 GHz: <15 kHz peak 8 - 12 GHz: <20 kHz peak 12 - 18 GHz: <30 kHz peak	
Leveled Output Power:	7 dBm min. @ 25°C, Opt. 10; 10 dBm min. @ 25°C	
Internal Leveling:	± 1.5 dB @ ≥ 25 msec, Bands 2, 3, 4; ≥ 100 msec Band 5 $\pm .75$ dB; Band 1	
External Leveling:	± 0.4 dB plus sampler variations. (May require external filter)	
Power Control Range:	>10 dB	
Harmonics:	>-20 dB down	
Non-Harmonics:	>-45 dB in all ranges except Band 1 when the leveled power is at maximum; except opt. 10, 4-8 GHz, where the harmonically related products of the oscillator are -20 dB. -25 dB in Band 1, when the leveled power is at maximum.	
Sweep Time:	<25 msec over 4 smaller ranges <100 msec over 2 - 18 range	
Dwell Time:	<4 msec	

TABLE I - 3

SPECIFICATIONS FOR 9514A/9515A SYSTEM
(Cont.)

External Pulse Modulation:	Rise Time 400 nsec Fall time 400 nsec On/Off Ratio 45 dB
VPF on 9515A:	1 V/.1 GHz in the frequency range of .1 - 2 GHz 1 V to 20 V 1 V/GHz in the frequency range of 2 - 18 GHz 2 V to 18 V Accuracy; $\pm 2\%$ of frequency dial
Dimensions:	10 - 1/2" high x 16 - 3/4" wide x 15 - 3/4" overall depth
Weight:	Approximately 80 lb.
Power:	115 V/220 V 50-60 Hz

SECTION II

OPERATION

2-1. RECEIVING INSPECTION

2-2. Upon receiving your Model 9514/9515, carefully unpack the instruments and check for shipment damage. If damage is evident, file a claim against the carrier. Refer to the Shipment Damage Claim form in the back of this manual.

2-3. Check the unit for shipping damage. The front panel controls should move easily, with full travel and positive detents. Note any mechanical damage, and check the condition of accessories shipped with the unit. If there is any damage or deficiency, or if electrical performance is not within specifications, see the warranty inside the front cover of this manual.

2-4. Inspect the units for humidity and heat damage after any long storage period. Minimum performance tests should be made after each of these inspections (paragraph 2-5). No attempt should be made to make any repairs to the Plug-in Unit or to make adjustments without complete familiarization with the information contained in Section IV.

2-5. PRELIMINARY INSPECTIONS

2-6. Preliminary inspection of the equipment is performed without operating power applied. This type of check is designed to detect conditions that might otherwise lead to

a breakdown. Frequency causes of premature failure are overheating, due to improper ventilation or accumulation of dust and dirt, and/or loose connections and fittings. Inspection is carried out with emphasis on finding evidence of these conditions. Table 2-1 lists the preliminary inspection checks for the equipment.

TABLE 2-1
PRELIMINARY INSPECTION CHECKS

Item	Inspect For	Corrective Action
Connectors	Looseness, bent or corroded contacts, signs of arcing	Clean contacts with cloth moistened with cleaning solvent trichloroethylene or equivalent. Replace connectors if damaged or deeply corroded.
Main Frame and front panel	Dirt and corrosion	Clean with cloth moistened with cleaning solvent trichloroethylene or equivalent.
Knobs, screws, connectors, clamps	Looseness	Tighten using appropriate torque so as not to strip threads.
Switches	Looseness	Tighten mounting screws or nut.
Wiring	Looseness Frayed, worn, or missing insulation	Resolder, recable, or reclamp. Replace as required.
Solder joints	Loose or cold solder connections; corrosion	Clean carefully and resolder, using recommended soldering iron.
Printed circuit boards	Mounting looseness Loose components	Replace mating plug if required. Resolder loose components.
Resistors	Cracks, chipping, blistering, discoloration, and other signs of overheating	Replace resistor.
Capacitors	Leaks, bulges, signs of aging Loose mounting bracket	Replace capacitor. Tighten nuts or screws holding bracket.
Switch contacts	Dirt, dust, and/or corrosion Bent or broken contacts	Clean with cloth, aerosol spray, syringe or camel-hair brush using trichloroethylene or equivalent. Replace switch wafer or assembly.
Transistors	Looseness	Seat firmly in sockets, or resolder leads to etched circuit.

2-7. POWER REQUIREMENTS

2-8. The 9514 operates when it is plugged into a 6600 Main Frame; power is supplied by the 6600. The 9515 uses 115 V or 230 VAC.

2-9. The unit is normally connected at the factory for operation at 105 to 125 VAC (115 VAC nominal) and 50 to 60 Hz. To convert to 230 VAC (nominal) line power, remove the line power cord from the rear-panel receptacle, and slide the plastic protective cover to expose the fuse. Remove the fuse, and slide the switch (with the arrow) to the 230 V position. Insert a new fuse.

NOTE

For 115 VAC, use a 1.6 A slow-blow fuse.

For 230 VAC, use a 3/4 A slow-blow fuse.

Slide the plastic cover back, and replace the line power cord in the receptacle. To reconvert to 115 VAC operation, reverse the above procedure.

2-10. CHASSIS GROUNDING

2-11. The chassis has a three-conductor power cord and a three-prong plug, which grounds the instrument when plugged into an appropriate receptacle. If a three-prong to two-prong adapter is used, ground the chassis by connecting the adapter pigtail lead to a suitable ground.

WARNING

Failure to ground the instrument properly can degrade its performance and stability, and could permit an above-ground potential on the chassis, which could be dangerous to operating personnel.

2-12. COOLING

2-13. Adequate space must be provided at the top, rear, and bottom of the 9515 for cooling purposes. Although forced air cooling is provided, space for flow of the cooling air is required. Allow one inch at the rear and top and one-half inch at the bottom.

2-14. REMOVING AND INSTALLING THE 9514 CONTROLLER

2-15. Removing the 9514:

- a. Disconnect cable assembly.
- b. Pull lock lever at front left side of 6600 down. The 9514 will then move out about an inch.
- c. Remove 9514.

2-16. Installing the 9514:

- a. Insert the 9514 through the front panel opening and push it into place.
- b. Push lock lever up.

2-17. FREQUENCY DIAL INSTALLATION

2-18. The Frequency Dial is installed as follows:

a. Select the frequency scale corresponding to the range of the 9515.

b. Place the beveled edge at the left end of the frequency scale under the lip

at left end of the Model 6600 frequency dial.

c. The corresponding lip at the right end of the Model 6600 frequency dial is spring-loaded. Slide it about 1/4 inch to the right, and place the frequency scale in position over the frequency dial.

d. Release the sliding lip and check to be sure that the scale is secure.

Calibration is required.

2-19. FREQUENCY DIAL POSITION CALIBRATION

2-20. Calibrate the Frequency Dial position as follows.

a. To the left of the dial is a conventional flat-head screw.

b. On the left end of the dial there are two calibration lines.

c. There are corresponding calibration dots behind the dial.

d. Use the flat-head screw to line up the calibration marks.

2-21. CONTROLS, INDICATORS, AND CONNECTORS

2-22. The front panel controls, indicators and connectors for the 9514 are illustrated in Figure 2-1 and described in Table 2-2. Similarly, the rear panel is shown in Figure 2-2 and described in Table 2-3. The front panel controls, indicators and connectors for the 9515 are illustrated in Figure 2-3 and described in Table 2-4. Similarly, the rear panel is shown in Figure 2-4 and described in Table 2-5.

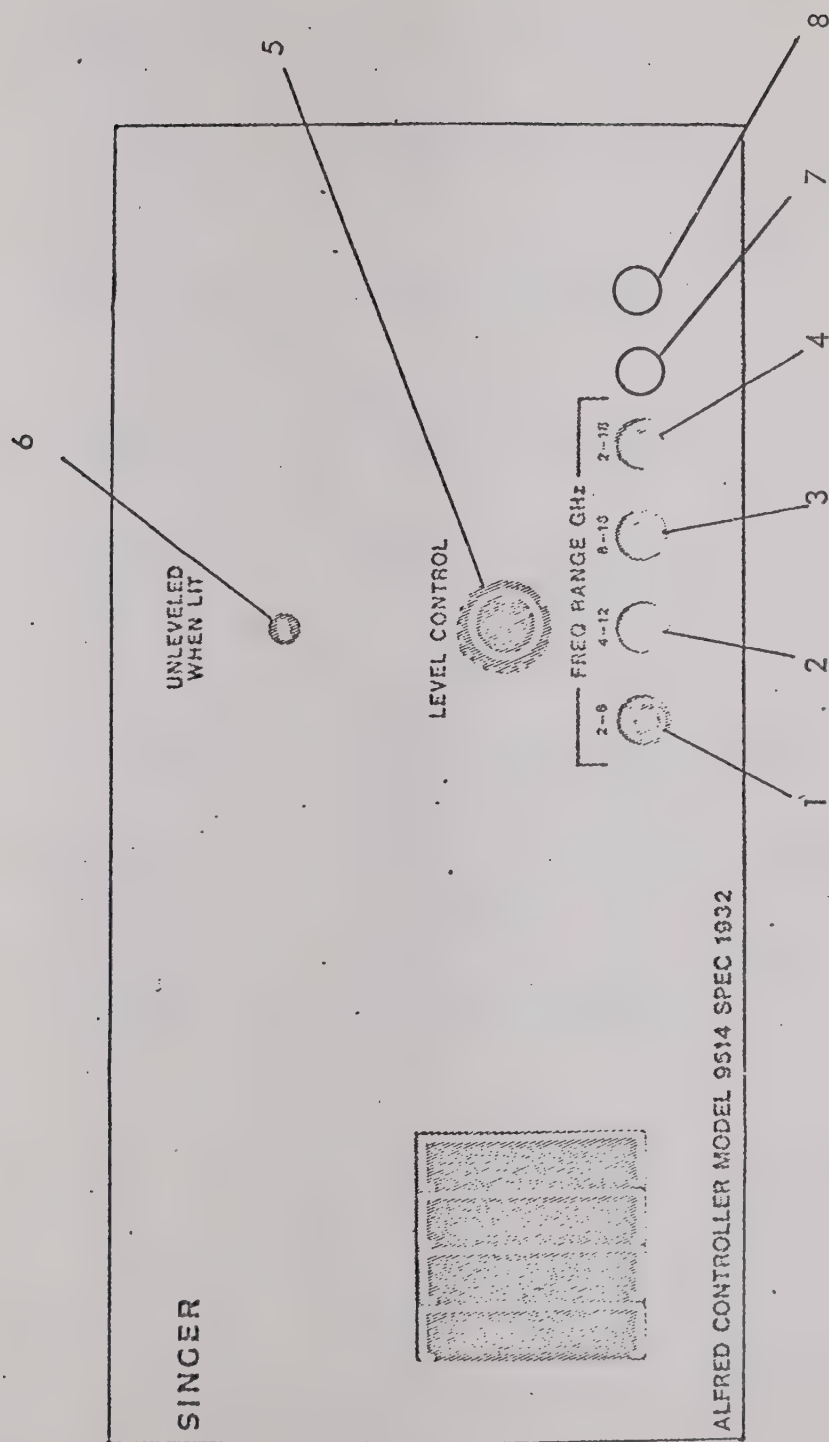


Figure 2-1. Model 9514 Controller Front Panel Controls, Switches, and Indicators

TABLE 2 - 2

MODEL 9514A CONTROLLER
FRONT PANEL CONTROLS, SWITCHES, AND INDICATORS

Index No.	Control, Switch, or Indicator	Function
1	Band Selector 2 - 8 GHz or .1 - 2 GHz	Selects 2 - 8 GHz or .1 - 2 GHz band coverage by swept or fixed frequency output.
2	Band Selector 4 - 12 GHz or 2 - 4 GHz	Selects 4 - 12 GHz or 2 - 4 GHz band coverage by swept or fixed frequency output.
3	Band Selector 8 - 18 GHz or 4 - 8 GHz	Selects 8 - 18 GHz or 4 - 8 GHz band coverage by swept or fixed frequency output.
4	Band Selector 2 - 18 GHz or 8 - 12.4 GHz	Selects 2 - 18 GHz or 8 - 12.4 GHz band coverage by swept or fixed frequency output.
5	Level Control	Determines leveled or unleveled RF output.
6	Unleveled When Lit	Indicates unleveled operation (unleveled or amplitude-modulated output) when light is lit.
7	Band Selector 12.4 - 18	Selects 12.4 - 18 GHz band coverage by swept or fixed frequency output.
8	Band Selector 2 - 18 GHz	Selects 2 - 18 GHz band coverage by swept or fixed frequency output.

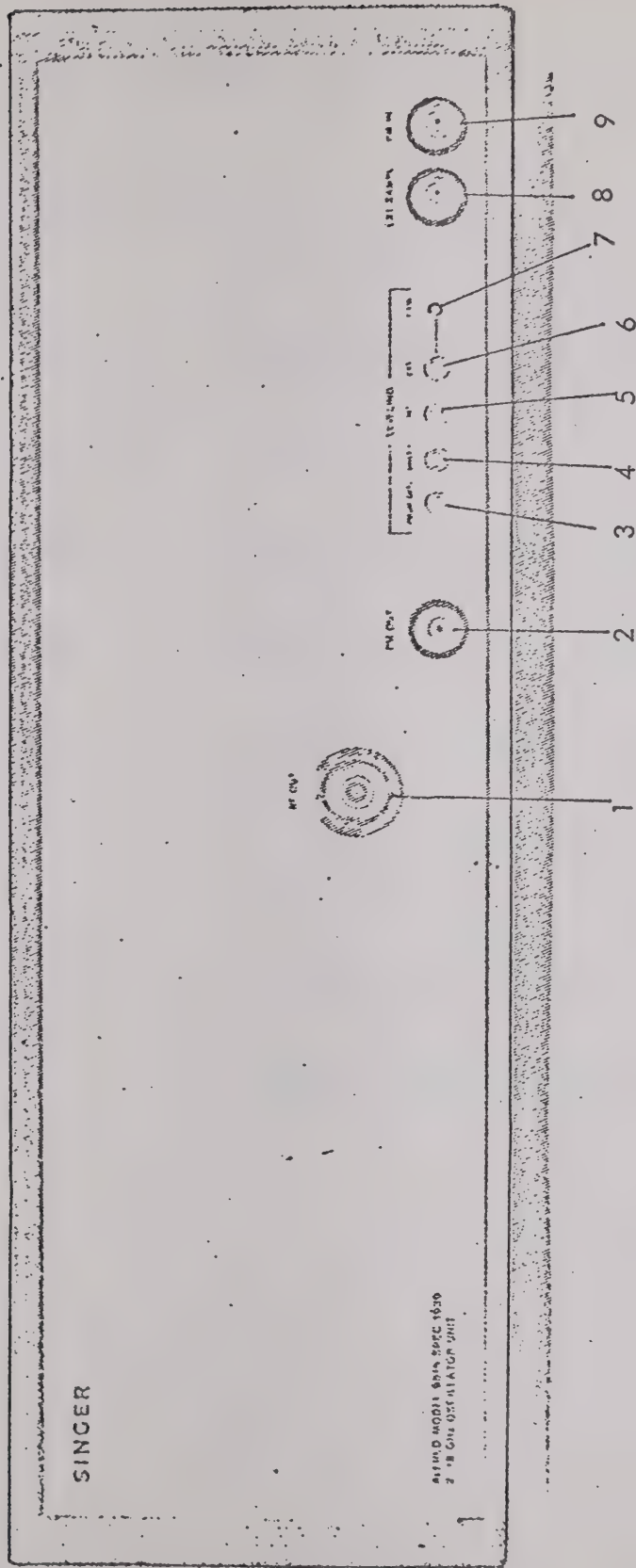


Figure 2-2. Model 9515 Oscillator Front Panel Controls, Switches, and Connectors

TABLE 2-4

MODEL 9515 OSCILLATOR
FRONT PANEL CONTROLS, SWITCHES, AND CONNECTORS

Index No.	Control, Switch or Connector	Function
	RF OUT	Connector for RF output.
	PM OUT	Output connector for +5 V pulse which corresponds to external PM or internal PM (Option _____).
	Leveling PM (RF OFF)	Cuts off RF output until a pulse is applied at PM IN.
	Leveling UNLEV	Selects RF output not leveled by feedback from internal or external sample of RF.
	Leveling INT	Selects leveled output controlled by internal sample.
	Leveling EXT	Selects leveled output controlled by external sample.
	Gain	Controls effect of external sample, hence level of RF OUT.
	EXT Sample	Connector for input of detected RF sample to control level of RF OUT.
	PM IN	Pulse Modulation In put connector, +1 to +5 V (maximum) turns RF Output ON.

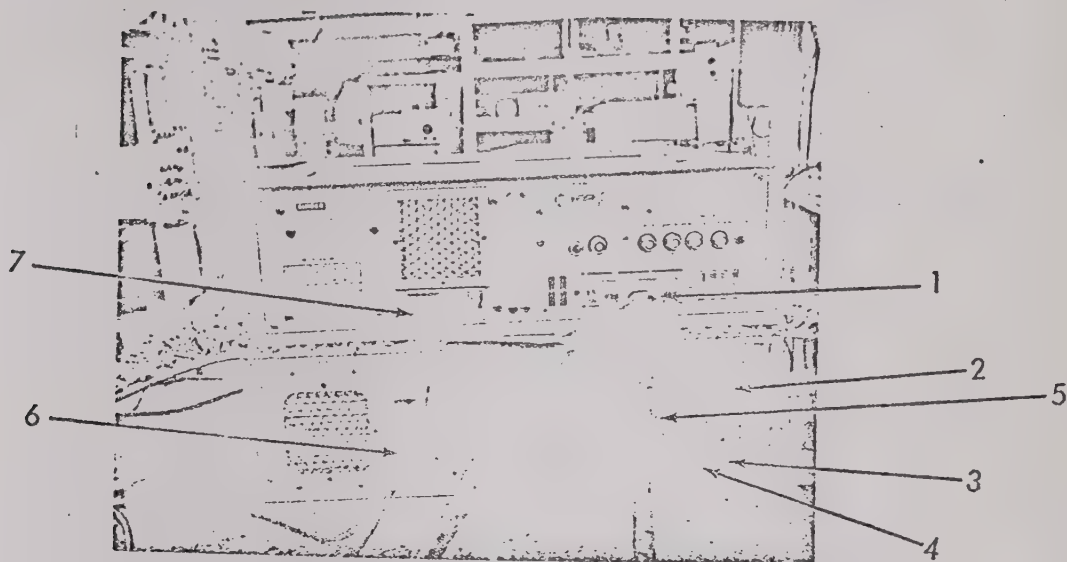


Figure 2-3. Model 9514/9515 Rear Panel Connectors

TABLE 2-4

MODEL 9514/9515 REAR PANEL CONNECTORS

1. 9514 Cable Connector to 9515
2. Remote Attenuator Jack, J3
3. FM Input Jack
4. Voltage Proportional to Frequency (VPF) Output Jack
5. 9515 Cable Connector to 9514
6. Power Input Connector for 9515
7. Power Input Connector for 6600

2-23. OPERATING INSTRUCTIONS FOR THE 9514/9515 SYSTEM

2-24. Turn-On Procedure

- a. Plug the 9514 into the 6600 Main Frame. Connect the 9515 to the 9514 by the Interconnect Cable. Plug the 6600 and 9515 line power cords into AC outlets.
- b. Ensure that the rear panel 115/230 volt switches are set for the correct line voltage. Check also for the correct fuse rating (see paragraph 2-9).
- c. Press POWER pushbutton on the 6600 to apply power, and ensure that the blower fans are operating.
- d. Allow the equipment to warm up for at least 15 minutes.

2-25. Sweep Frequency Operation

2-26. There are three recurring sweep modes: Full Band, Marker Sweep, and F Narrow Band Sweep.

2-27. Full Band Sweep. In Full Band sweep mode, the unit sweeps across the entire frequency range selected by the 9514 Controller. The sweep is in the direction of increasing frequency with all markers (M1, M2, and F_0) present at the RF output of the 9515. Full Band sweep is convenient for quick testing over an entire band. For Full Band sweep, set the controls as follows:

- a. FULL BAND pushbutton; depress. Observe that respective indicator illuminates.
- b. RF BLANKING pushbutton; depress if RF output is to be off during sweep retrace. Observe that respective indicator illuminates.

- c. SWEEP TIME (SEC) pushbuttons; select and depress for desired sweep time range. Observe that respective indicator illuminates.
- d. SWEEP TIME VAR; set for desired sweep time. Note that CAL position (fully counterclockwise) is for calibrated sweep time equal to SWEEP TIME (SEC) selected.
- e. TRIGGER mode pushbuttons; depress for desired sweep trigger mode.
- f. Read marker positions at appropriate scale of frequency dial. Adjust marker amplitude using the MARKER AMPL control. Use the MARKER pushbutton to enable RF marker generation. Video markers are not controlled by the MARKER pushbutton.

2-28. Marker Sweep. Marker sweep mode is similar to the Full Band sweep mode, but is convenient for testing over narrower portions of the band. The Marker Sweep start and stop points can be set anywhere within the band for either a frequency upswing or downswing. The sweep always starts at M1, and stops at M2. To operate the Marker Sweep -- for example, to bracket the sweep about any portion of the band -- proceed as follows:

- a. Using M1 and M2 controls, set markers (read at top scale of frequency dial) to the desired sweep start and stop points. For downswing, set M1 above the frequency of M2.
- b. Depress M1→M2 pushbutton to enable the Marker Sweep mode.
- c. Set the sweep time, blanking, etc., controls for convenience, as in Full Band sweep. Note that only the F_0 marker operates in Marker sweep mode.
- d. Activate RF marker generation by pressing the RF MARKER pushbutton. Adjust the marker amplitude with the MARKER AMPL control.

e. To disable F_0 marker generation, turn MARKER AMPL control to OFF, or press RF MARKER pushbutton off to disable RF marker only.

2-29. ΔF NARROW-BAND SWEEP

2-30. The ΔF sweep is a narrow-band sweep that is symmetrical about the F_0 center frequency. The ΔF sweep extends from $-(\Delta F)/2$ to $+(\Delta F)/2$ about F_0 as read on the ΔF scale. Maximum sweep width is 20% of the full band. The F_0 and ΔF controls operate independently of one another and can be reset during narrow-band operation to obtain the desired ΔF window at the desired F_0 center frequency. To operate in ΔF mode, proceed as follows:

a. Press $\begin{matrix} F_0 \\ \longleftrightarrow \\ \Delta F \end{matrix}$ pushbutton to place unit in narrow-band sweep mode.

b. Adjust ΔF control to the desired narrow-band sweep width, as read on the F scale.

c. To center fixed ΔF window (narrow-band sweep) to any frequency, tune the F_0 control to the point of interest.

NOTE

Do not set the F_0 and ΔF controls such that the ΔF sweep would extend outside the 9515.

2-31. OTHER MODES OF OPERATION

2-32. Other control arrangements and auxiliary output signals are essentially the same as for Marker or Full Band sweep. However, note the following differences:

1. The F_0 marker is inoperative, but the M1 and M2 markers operate just as in Full Band sweep. See paragraph 3-10.
2. The sweep time controls set the sweep time from $-(F)/2$ to $+(F)/2$.
3. The VPF (voltage-proportional-to-frequency) output in the F mode is two volts or less, peak-to-peak, since the frequency band is no wider than 20% of full band. Thus, when the sweep mode is switched from Full Band to F, the sweep output ramp remains at 10.5 volts, but the VPF output decreases. The front-panel SWEEP indicator light is ON for the duration of each sweep from $F_0 - (F)/2$ to $F_0 + (F)/2$.

2-33. OTHER CONTROL FUNCTIONS

2-34. See the Model 6600 Instruction Manual for operating instructions for various trigger functions, various modulations, etc.

2-35. OPERATING INSTRUCTIONS FOR THE 9514 CONTROLLER AND 9515 OSCILLATOR

- a. Insert controller Model 9514, Spec 1915, in Sweeper Main Frame 6600.
- b. Connect controller 9514 to oscillator unit 9515, Spec 1916, with interconnect cable (J1 to J1).
- c. Connect power cord to Sweeper Main Frame 6600 and plug in power outlet.
- d. Connect power cord to oscillator unit 9515 and plug in power outlet.

- e. Turn on 6600 Main Frame according to directions in paragraph 3-6. This automatically activates the 9515 via the 9514.
- f. Select internal leveling on front of 9515.
- g. The oscillator output is provided via an N connector at the front of the 9515 and the frequency is determined by the band selection switches on the 9514 and dial settings on the 6600 Main Frame.
- h. The mode of operation is determined by the 6600 control settings, which are given in the manual for the 6600, Section III.
- i. All specifications applicable to the 6600/9514/9515 Wideband Sweeper System are outlined in Table 1-1.

2-36. MINIMUM PERFORMANCE STANDARDS TEST PROCEDURE

2-37. Upon receipt of equipment and after any long period of storage, the Minimum Performance Standards Test Procedure should be followed. Test equipment necessary for performance of these tests are listed in Table 2-5. The tests are described in Table 2-6. If the instruments do not give specified performance, refer to Table 4- for adjustment procedures. Refer to paragraph 4- et seq. for Troubleshooting Procedures, to find faulty circuits, if adjustments in Table 4- are not adequate.

TABLE 2-5

RECOMMENDED TEST EQUIPMENT FOR 6600 - 9514 - 9515 SWEEP SYSTEMS

Test Equipment	Critical Specifications	Manufacturer and Model
Network Analyzer		Singer 8000/7051
Frequency Counter		EIP-DANA Lab 351 B/C
Spectrum Analyzer		HP8555A
Oscilloscope		Tektronix 500 Series and HP183A
Oscilloscope Plug-in		Tektronix Type 1A7 and HP1830A; HP1840A
Power Meter and Thermistor Mount	Power range: 100 μ W to 10 MW	HP432A and HP8478B
Digital Voltmeter		Fluke 8300A
Attenuator Pad	10 dB (DC - 18 GHz)	HP or NARDA
Crystal Detectors		HP8470A
Marker Generator	100, 25 and 5 MHz Marker	Singer Model 7300
Pulse Generator	Rise and Fall time: 10 nsec Rep. rate: 10 to 10 MHz	Data Pulse 101
Resistor Decade Box (2 minimum)		1 ohm to 1 M ohm 1% in 1% steps
Current Meter		HP428B
Service Kit for Model 6600		Singer P/N 102-0200-001
1 - Model 6602 Test Plug-in		103-2701-001
1 - Model 6600A Extender Plug-in		952910
1 - PCB Extender, non-heatsink		103-2230-001
1 - PCB Extender, heatsink		103-2231-001
2 - Extension Cables DIP connectors		102-9205-001
1 - Extension Cable, Power Supply		102-9206-001
1 - Lamp Extractor tool		175-0003-001
Service Kit for Model 9515A		Singer P/N 102-0211-001

TABLE 2-6

MINIMUM PERFORMANCE STANDARDS TEST PROCEDURES

Flatness Specification Test

To test whether this specification is met, proceed as follows:

1. Hook up the 6600 - 9514 - 9515 combination.
2. Switch the 6600 to the mode:
 - a. Full band
 - b. Internal Trigger
 - c. Sweep speed 100 msec.
 - d. Blanking ON
3. Switch the 9515 to the internal leveling mode.
4. Connect a 8000/7051 Network Analyzer to the RF output of the 9515 and to the Sweep Out Jack of the 6600. The 8000/7051 should be calibrated first so 10 dBm serves as a reference line with 1 dB/division sensitivity.
5. Turn on the power of the 6600 and wait 15 minutes.
6. The Network Analyzer should display a leveled trace ± 1 dB regardless of which band has been selected on the 9514. The RF power should be adjusted on the 9514 in order to display minimum of 10 dBm on the Network Analyzer. Power out must stay within ± 1 dB for average output levels from 0 dBm to 10 dBm. If leveling is out of specification, go to Paragraph 5-4.
7. Switch the 9515 in the unleveled mode.
8. Turn the RF power control on the 9514 fully clockwise.

TABLE 2-6

MINIMUM PERFORMANCE STANDARDS TEST PROCEDURES (CONTINUED)

9. The analyzer should display an unlevelled trace with a minimum power of 10 dBm in any band selected on the 9514.
10. Turn the RF power control fully counter clockwise.
11. The power level trace should be at least 10 dB less than the trace measured in step 10. If this specification is not met, go to Paragraph 5-4.

Frequency Accuracy and Voltage Proportional to Frequency Accuracy

1. Interconnect the combination 6600 - 9514 - 9515.
 2. Switch the 6600 to CW mode.
 3. Select the 2 - 8 GHz band on the 9514.
 4. Connect a counter at the output of the 9515.
 5. Connect a DVM at the VPF output of the 9515 and a DVM at the VPF output of the 6600.
 6. Turn the unit on.
 7. Turn F_0 anywhere on the band selected on the 9514.
 8. The frequency counter reading must match the F_0 dial markings and the 6600 VPF and the 9515 VPF voltage readings must match the values shown in Table 2-7, $\pm 2\%$.
 9. Switch the 6600 to the $M1 \rightarrow M2$ with $M1$ marker lower in frequency than $M2$.
 10. Select on the 6600: internal triggering, blanking on and a sweep speed of 0.1 sec.
 11. Connect a Singer 7300 to the 9500 (with a scope as read out) as outlined in the Instruction Manual of the 7300.
 12. The two DVM's may be disconnected.
 13. The 7300 and scope combination should display evenly spaced markers as a function of the sweep width $M2 \rightarrow M1$ and the selection of the band on the 9514.
- Frequency linearity should vary less than $\pm 1\%$.

TABLE 2-6

MINIMUM PERFORMANCE STANDARDS TEST PROCEDURES (CONTINUED)

FM Performance Test

1. Switch 6600 to CW mode by depressing F_0 .
2. Band selector of 9514: any position.
3. Connect a power supply with a voltage of -10 to $+10$ volt into the input FM.
4. Connect a counter at the output of the 9515.
5. Measure the frequency deviation vs. power supply voltage. Deviation is at least $\pm .35\%$ except in the 4 - 8 GHz band. In the 4 - 8 GHz band it should be at least $\pm .12\%$ for an FM input of ± 10 V.
6. Disconnect the frequency counter.
7. Disconnect the power supply.
8. Connect a Spectrum Analyzer at the output of the 9515.
9. Connect an audio generator or function generator to the FM input of the 9515.
10. Measure the deviation on the Spectrum Analyzer. The bandwidth should be at least 100kHz for a frequency deviation of $1/10$ of that measured in step 6 with the generator producing ± 10 volt peak to peak excursions.

TABLE 2-7

CALIBRATION CHART FOR MODEL 9515

6600 VPF Reading Volts	Output Frequency: GHz $\pm$ 1% and VPF: Volts, from 9515				
	GHz 2 - 8 Band	4 - 12	8 - 18	2 - 18	.1 - 2
0.000	2.000	4.000	8.000	2.000	1.000
1.000	2.600	4.800	9.000	3.600	2.900
2.000	3.200	5.600	10.000	5.200	4.800
3.000	3.800	6.400	11.000	6.800	6.700
4.000	4.400	7.200	12.000	8.400	8.600
5.000	5.000	8.000	13.000	10.000	10.500
6.000	5.600	8.800	14.000	11.600	12.400
7.000	6.200	9.600	15.000	13.200	14.300
8.000	6.800	10.400	16.000	14.800	16.200
9.000	7.400	11.200	17.000	16.400	18.100
10.000	8.000	12.000	18.000	18.000	20.000

SECTION III

THEORY OF OPERATION

3-1. GENERAL FUNCTION OF 9514A/9515A

3-2. The 6600/9514A/9515A combination forms a very wide band sweep frequency microwave generator. Available frequencies are those from .1 GHz to 18 GHz. Linear sweeps of the bands, .1 - 2 GHz, 2 - 8 GHz, 4 - 12 GHz, 8 - 18 GHz, and 2 - 18 GHz or .1 - 2, 2 - 4, 4 - 8, 8 - 12.4, 12.4 - 18 and 2 - 18 are available, as is constant frequency operation.

3-3. The Model 6600 Main Frame supplies sweep voltages, trigger functions, and various modulations. The specific functions of the 6600 are discussed in the 6600 manual. The following discussions will describe action of the 9514/9515 circuits, with the 9514 controller plugged into the 6600 Main Frame and with the 9515 oscillator connected to the 9514 and to 60 Hz power, as indicated in Section II.

The 9514 Controller

As shown in Figure 3-1, the 9514 is a connection chassis and a code converter. The 0 to +10 volt tuning voltage sweep from the 6600 is connected to conversion circuits in the 9515. Modulation signals are connected to the 9515. Band selection signals (3 bit binary) from an external computer (via the Computer Control Circuit, Option 5; see paragraph 2-) are changed to 7 wire digital control signals and sent to the 9515. Pushbutton band selections are also connected to the 7 wire band controls wires. RF output level is controlled by a potentiometer (Level Control) mounted in the 9514 front panel. An UNLEVELED WHEN LIT light in the front panel is driven by the 9515.

The 9515 Controller

The 9515 oscillator is a group of four microwave oscillators, with leveling circuits, tuning voltage conversion circuits, FM Drivers for the oscillators, and the logic needed to provide 4 bands of continuously swept frequencies. The Control Logic, driven by band selection

signals from the 9514, selects sweep signals and provides timed switching to give continuous RF from two oscillators in each of three bands and from four oscillators in one (2 - 18 GHz) band.

The four oscillators produce RF power continuously. Output is selected and leveled by a four channel PIN Diode Attenuator which allows to pass only the outputs of the desired oscillators.

The sweep voltages which tune the oscillators are converted from the 0 to +10 volt linear sweep which is produced in the 6600. The timing for changing from one oscillator to another during a sweep is also taken from the linear sweep. Hence switching to a second oscillator occurs precisely as the first oscillator reaches the end of its frequency band and the second oscillator produces the same frequency and sweeps through its band.

The FM Driver modulates the tuning of each oscillator by feeding current through a coil in the oscillator. Negative feedback provides current directly proportional to FM input voltage.

Because of additional power requirements, beyond the normal capabilities of the 6600, the 9515 has a built in power converter to change 115 volts, 60 Hz to ± 20 volts, -11 volts, +5 volts, etc.

Output power leveling is provided by the Leveling Circuit, which controls the attenuator. Inputs for leveling may be either a built in sample detector at the output of the attenuator or an output sample detector, of either negative or positive polarity, as selected by the operator. Overall level of RF power is controlled by a bias selected on the 9514 Level Control.

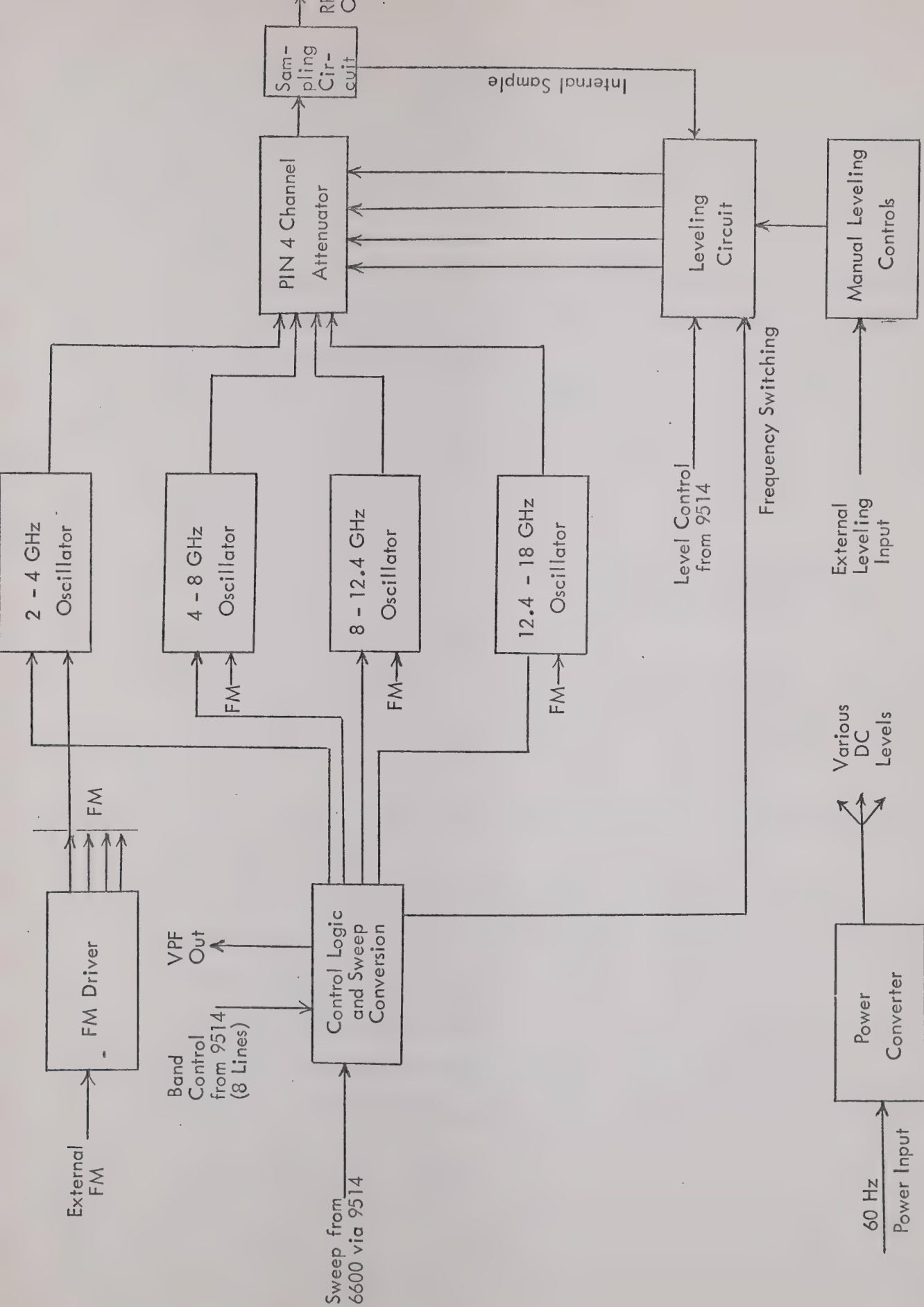


Figure 3-2. 9515 Block Diagram

SECTION IV

MAINTENANCE

4-1. GENERAL

4-2. The Model 9514 Plug-in Unit is only used when it is plugged into a Model 6600 Main Frame. The environmental conditions for operation of the 9514 and 9515 are the same as for the 6600. Storage temperatures should not exceed 75°C, as is typical for electronic gear. If there is long time storage at or above this temperature, the Performance Standards Test Procedure should be completed before the units are put back into use.

4-3. PACKAGING FOR SHIPMENT

4-4. To repackage for shipment, use the original shipping container and packing materials. If these have been discarded or are not reuseable, contact your local Singer sales and service office, or follow these general instruction.

- a. Wrap the instruments in heavy paper or plastic. (If the instrument is being shipped to a Singer service facility, attach a tag with the information listed on the back of the title page.
- b. Use a strong shipping container. A carton made of 600-pound test material should provide adequate protection.
- c. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of the instrument to provide a firm cushion and to prevent movement inside the container. Protect the control panel with cardboard.
- d. Seal the shipping container securely.
- e. Mark the shipping container "FRAGILE" to assure careful handling. In any correspondence, refer to the instruments by model number and full serial number.

4-5. TROUBLESHOOTING, GENERAL

4-6. The troubleshooting procedures which follow are based on signal tracing through the circuits which might cause the troubles. These procedures, as written, will trace troubles

to the functional schematics which are shown. Some procedures point out particular parts which may be at fault. Voltmeter and oscilloscope measurements at various points in the circuits are given on the diagrams. A check of variations from the given values will usually give firm indication of the part which is at fault. Detailed descriptions of circuit operation immediately precede each schematic. All of the procedures in this section should be performed with the 9514 installed in a 6600 Main Frame, and with the 9515 connected to the 9514 and to 115 V, 60 Hz. This is required to provide power and a sweep signal for the oscillators. The 9514 may be connected to the 6600 Main Frame by an extender cable Model 6602A.

TABLE 4-1

NO LIGHTS, NO RF POWER

Step	Procedure	Result	Next Procedure
1	Check condition of fuse, line cords, power switch on 6600 (front panel), power switch (115 V - 230 V, back panel)	a. Fuse blown. b. Power switch (front panel) does not always turn power ON. c. Back panel switch in wrong position. d. Power cord is open. e. All O.K.	a. Replace fuse, but note that a blow fuse is usually caused by a shorted capacitor, transistor, or diode or by lack of insulation on a conductor. b. Replace power switch, if problem is not unsoldered or broken connection to switch. c. Correct switch position. Put in proper fuse for voltage supplied. d. Repair or replace power cord. e. Check transformer terminals, in 6600 power supply, for proper input and output voltages. Look for possible short circuit. See 6600 manual.

TABLE 4-2

NO RF POWER, PANEL LIGHTS OPERATE

Step	Procedure	Result	Next Procedure
1	Check 9515 power cord to 60 Hz source	a. Cord open or disconnected. b. Cord O.K.	a. Replace cord or connect it, as needed. b. Go to Step 2.
2	Measure voltages supplied by 6600. Measure voltages produced by 9515. Check against voltages shown on schematic.	a. 6600 voltages are low (one or more). b. 6600 voltages are O.K. 9515 produces no or incorrect DC voltages. c. 6600 voltages are O.K. 9515 voltages are O.K.	a. Disconnect 1914 from 6600. Replace plug-in or test drawer. Go to Step 3. b. Go to Step 4. c. Go to Step 5.
3	Measure voltages supplied by 6600, using extender drawer for 9514.	a. Voltages O.K. b. Voltages are low.	a. Go to Step 4. b. Troubleshoot 6600. See 6600 manual.
4	Replace 9514 in 6600. Check operation of relay K1, in 9515 Power Supply, A14. Voltage across E9, E10 of PCB should be: 115 V, 60 Hz when 6600 is OFF, zero volts when 6600 is ON.	a. No voltage with 6600 OFF. b. Voltage appears with 6600 ON.	a. Check for: failed fuse in 9515 power module, faulty power cord. Replace as needed. If fuse blows when replace, find shorted rectifiers or capacitors in power supply. b. Check voltage to relay coil, J1-14, 15. Should be 22 volts DC. If not, trace back to 6600. If 22 volts, replace relay, K1.
4A	Measure voltages at 1A (Negative Tuning Ramp) and 14 (+15 V, approx.) of 2-4 GHz, 8-12.4 GHz, and 12.4-18 GHz YIG Driver boards. Measure	a. Voltages are OK. b. One or more voltages are not present.	a. Go to Step 5. b. Replace fuses, F1, F2, or F3 on YIG Driver boards. Troubleshoot tuning voltage drive circuit and/or oscillator voltage regulator, if fuse is not sufficient. On

NO RF POWER, PANEL LIGHTS OPERATE (CONTINUED)

Step	Procedure	Result	Next Procedure
4A Cont.	voltages at 28A (Negative Tuning Ramp) and 14 (+15 V approx.) of 4-8 GHz VCO Driver board.		VCO Driver board, check oscillator voltage regulator and/or Tuning Voltage Drive circuit. Trace voltages from input to output, using schematic voltage readings to determine where voltage disappears.
5	Check for RF into each channel of attenuator.	a. RF present. b. No RF.	a. Go to Step 6. b. Check voltages into oscillators. If ok, replace faulty oscillator. If not proper, go to Step 7.
6	Measure voltage into 12.4-18 GHz attenuator channel, with Full Band (2-18 GHz) selected. Read on oscilloscope. Voltage should be ground for approximately 1/4 of sweep time, +3.3 volts for approximately 3/4 of sweep time.	a. Voltage is correct. b. Voltage is always at ground. c. Voltage is always positive.	a. Attenuator is bad. Replace or return to factory for repair. b. Attenuator is bad. Replace or return to factory for repair. c. Attenuator may be OK. Go to Step 7.
7	Use oscilloscope to check wave form at pin 12 of U8, on Leveling PCB, A4. Voltage should be positive for 1/4 of sweep time, and ground for 3/4 of sweep time. See voltage and waveform figures on schematic.	a. Voltage is constant, near ground. b. Voltage is proper.	a. Check input to 34B, Ku Band Select. Should be as shown in Procedure 7. If it is, replace U7 or U8. If not, go to "Improper Output Frequencies." b. Trace wave form through U12 and Q34. Gain should be approximately 3 to Q34 emitter. Replace faulty part. If voltage at Q34 emitter is proper, go to Step 8.

NO RF POWER, PANEL LIGHTS OPERATE (CONTINUED)

Step	Procedure	Result	Next Procedure
8	Following Step 7, check for open collector in Q34 and/or shorted Q32 or Q33.	a. Open or short. b. Transistors OK.	a. Replace bad transistors. b. Check input to 6A. If positive voltage, trace back to source; should be ground. If ground, go to Step 9.
9	Trace RF cut-off signal through U7; pin 10, Q29, Q30, Q31, Q32. Compare with schematic voltages.	a. Voltages do not match schematic. b. Voltages OK until collector of Q32.	a. Replace bad parts. b. Check C40 for short. Replace, if shorted.

4-7. POWER SUPPLY, A1

4-8. The power supply is composed of a transformer, five bridge rectifiers with single-capacitor filters, a power input control relay, and an input power module, with 115/230 volt switch and a fuse. Resistors across the filter capacitors provide voltage drain if there is no load on the power supply. Capacitors C8, C9, and C10 across bridge inputs, reduce RF interference caused by voltage slope reversals in the bridge circuits. Bridges CR1 and CR2 are physically close to the transformer, with short conductors, so the RFI capacitors are not needed across them. Relay K1 is driven by +10.5 volts and -10.5 volts from the 6600, via the 9514, so that power is applied to the 9515 whenever the 6600 is turned ON.

4-9. REGULATOR #1 BOARD, A13

4-10. The Regulator #1 Board, A13, regulates plus and minus 20 volts, plus 5 volts, plus 1 volt, plus 19 volts, and minus 11 volts. These regulators provide general purpose power for the 9515. Circuits are standard series regulators. A schematic of all of the circuits on the board is in Section VI.

4-11. +20 V REGULATOR

4-12. The +20V Regulator supplies stable +20 volts for general use in the Model 9515. Power input is +24V. The reference voltage is across CR4, a zero temperature coefficient zener diode.

4-13. The differential amplifier U1 compares the reference voltage with a portion of the output voltage determined by the setting of R14. Output of U1, via Q3, drives Q1, the series regulator, which holds output voltage constant.

4-14. Excess output current turns on Q2, which takes current from the base of Q1, thereby limiting output current. The circuit is also protected against extreme loads by Zener diode CR1. If the limited output current cannot hold the output voltage up to 5 volts, CR1 conducts, and Q2 draws more current, thereby cutting off Q1 and folding the output current and voltage back to zero, except for less than 1 mA flowing through CR1. CR2, a Zener diode, sets the bias voltage for the driver transistor, Q3.

4-15. -20 V REGULATOR

4-16. The -20 V Regulator supplies stable -20 volts for general use in the Model 9515. Power input is -24 V. The reference voltage is +20 volts.

4-17. The differential amplifier U2 compares the reference voltage with the output voltage with exact balance determined by the setting of R26. Output of U2 via Q6, drives Q4, the series regulator, which holds output voltage constant, so that the input to U2 is ± 1 mV from ground.

4-18. Excess output current turns on Q5 which takes current from the base of Q4, thereby limiting output current. The circuit is also protected against extreme loads by Zener diode CR6. If the limited output current cannot hold the output voltage up to -5 volts, CR6 conducts, and Q5 draws more current, thereby cutting off Q4 and folding the output current and voltage back to zero, except for less than 1 mA flowing through CR6.

4-19. +5 VOLT REGULATOR

4-20. The Volt Regulator supplies +5 volts for logic circuits not isolated from ground. Power input is +8 V. The reference voltage is +10.5 volts.

4-21. The differential amplifier U3 compares the reference voltage with the output voltage via voltage divider R37 and R38. Output of U3 drives Q10, the series regulator, which holds output voltage constant, so that the differential input to U3 is ± 1 mV. Output voltage is determined by R37 and R38, which place terminal 3 of U3 at exactly +5 volts; hence the regulator output is +5 volts.

4-22. Excess output current turns on Q1 which takes current from the base of Q10, thereby limiting output current. CR7 prevents the +5 volt output from going more negative than ground potential. CR9 causes Q11 to saturate and cut off current to Q10, thereby stopping output current, if the output voltage drops close to ground.

4-23. -11 VOLT REGULATOR

4-24. The -11 Volt Regulator supplies negative voltage for use in various assemblies. Power input is -13V. The reference voltage is +10.5 volts.

4-25. The differential amplifier U4 compares the reference voltage with the output voltage via voltage divider R44 and R46. Output of U4 drives Q12, the series regulator, which holds output voltage constant, so that the input to U4 is ± 1 mV from ground. Output voltage is determined by R44 and R46.

4-26. Excess output current turns on Q13 which takes current from the base of Q12, thereby limiting output current. CR8 prevents the -11 volt output from going more positive than ground potential. CR10 causes Q13 to saturate and cut off current to Q12, thereby stopping output current, if the output voltage drops close to ground.

4-27. +1.0 VOLT REGULATOR

4-28. The +1.0 Volt Regulator supplies +1 volt to a microwave switch on the RF Assembly, A . Power input is +5V. The reference voltage is -10.5 volts.

4-29. The differential amplifier, composed of Q8 and Q9, compares the reference voltage with the output voltage via voltage divider R30, and R31. Output of Q8 drives Q7, the series regulator, which holds output voltage constant, so that the input to Q9 is at ground potential. Output voltage is determined by values of R31 and R30.

4-30. REGULATOR #2 BOARD, A12

4-31. The Regulator #2 Board, A12, regulates +10.5 V, -10.5 V, +5 V floating, and - Program volts. The regulator circuits are similar to the regulator circuits on the Regulator #1 Board. Descriptions of the individual circuits follow. A schematic of all of the circuits on the board is in Section VI.

[illegible]

4-32. +10.5 V REGULATOR

4-33. The +10.5 V Regulator supplies stable +10.5 volts for reference use in the Model 9515. Power input is +20 volts. The reference voltage is across CR1, a zero temperature coefficient Zener diode, which is further stabilized by a positive temperature coefficient resistor-heater in the 45T1-1 oven. Oven power is taken from +24 volts, but voltage to the oven heater is held stable by Q14, the +19 Volt Regulator, on Board A13.

4-34. The differential cascode amplifier formed by Q3, Q4, and Q5 compares the reference voltage with a portion of the output voltage determined by the setting of R8. Output of the differential amplifier is amplified by U1, which drives the series regulator Q1, which holds output voltage constant.

4-35. Excess output current turns on Q2, which takes current from the base of Q1, thereby limiting output current. CR2 limits collector to base voltages of Q5 to less than 1 volt.

4-36. -10.5 VOLT REGULATOR

4-37. The -10.5 V Regulator supplies stable -10.5 volts for reference use in the Model 9515. Power input is -20 V. The reference voltage is +10.5 volts.

4-38. The differential cascode amplifier formed by Q8, Q9, and Q10, compares the reference voltage with the output voltage with exact balance determined by the setting of R22. The differential amplifier output is amplified by U2, which drives the series regulator, Q8, which holds output voltage constant.

4-39. Excess output current turns on Q7, which takes current from the base of Q6, thereby limiting output current. CR3 limits collector to base voltages of Q10 to less than 1 volt.

4-40. - PROGRAM VOLTAGE REGULATOR

4-41. The - Program Voltage Regulator supplies required negative voltage for use in the Plug-in Unit. Power input is -62V. The reference voltage is +10.5 volts.

4-42. The differential amplifier U3 compares the reference voltage with the output voltage via voltage divider R28, R29, R30, and R31. Output of U3 drives Q11, the series regulator, which holds output voltage constant, so that the input to U3 is ± 1 mV from ground. Output voltage is determined by setting of R31 and value of R30.

4-43. Excess output current turns on Q12 which takes current from the base of Q11, thereby limiting output current.

4-44. +5 VOLT FLOATING REGULATOR

4-45. The +5 Volt Floating Regulator supplies +5 volts to logic circuits which must be isolated from ground. The power supply for it is +8 volts from module A1. There are no connections to ground in either Power Supply, A1, or the regulator circuit on A12. The regulator is an integrated circuit designed to deliver +5 volts when supplied with a fairly wide range of supply voltages. The type is UA7805. The reference designator is U4.

4-46. TUNING RAMP AND VPF RAMP CIRCUITS, A5

4-47. The Tuning Ramp supplied to the oscillators is derived from signals produced by the 6600. Ramp and bias voltages are supplied as F1, F2, and F3, into pins 9, 34, and 8 of the cable connector on the connector Board A5. These signals are mixed at the input to U2. The output of U2 is twice the sum of the input voltages, gain being determined by resistors R5, R6 and R7. This output is supplied to the VCO and YIG tuned oscillators through pins 25B and 33B of the Mother Board connector.

4-48. The VPF Ramp is a positive voltage directly proportional to output frequency. For an output of 4.0 GHz, the VPF voltage is +4.0 volts. For 16.0 GHz, it is 16.0 volts.

4-49. The input ramp, which is 0 to +10.5 volts for a Full Band sweep, is supplied through current limiting resistors to the inverting input of U3, which has a gain of one for the ramp voltage at the input to R44. Odd numbered resistors R15 through R25 and resistor R74 determine the voltage at that point.

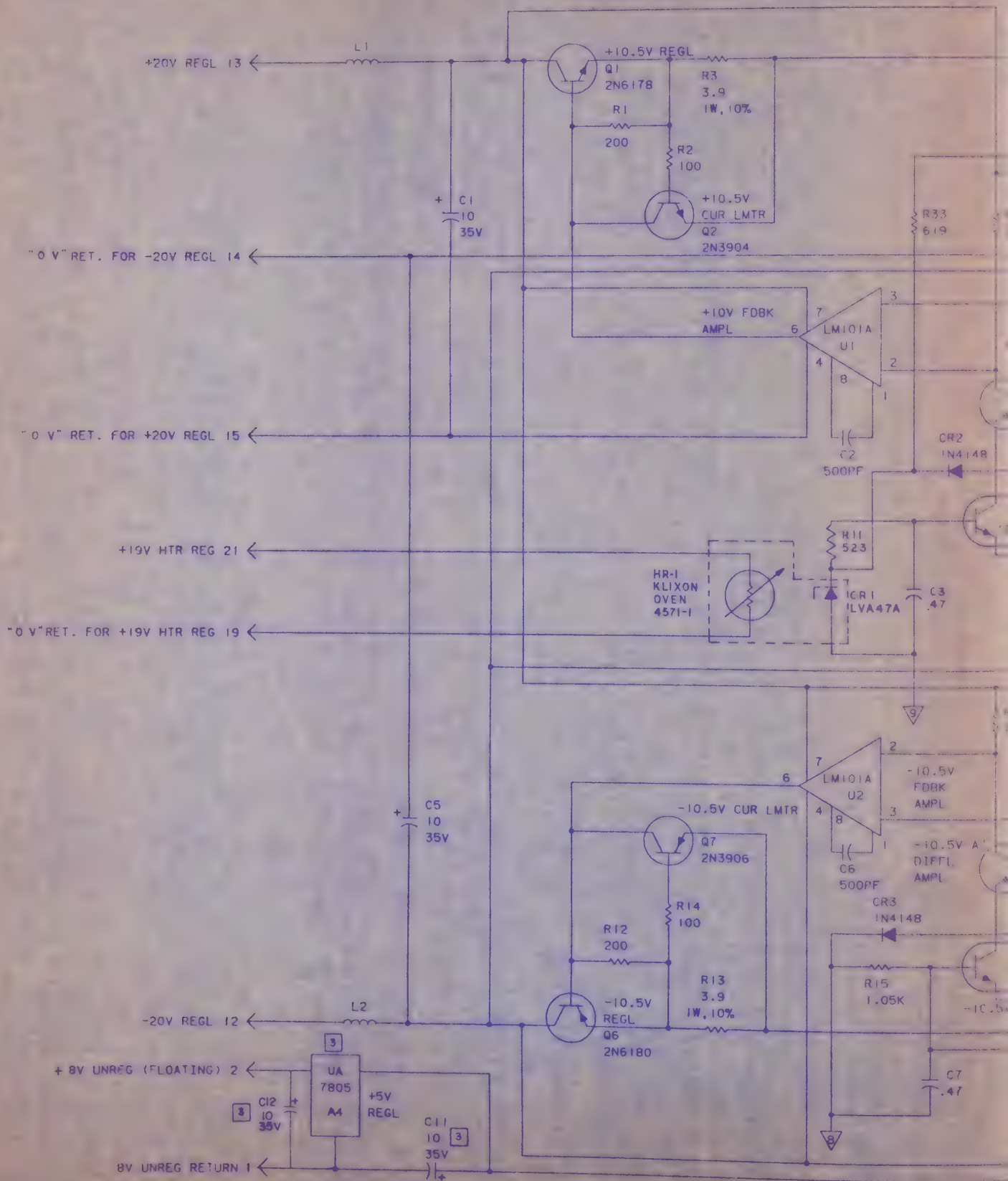
NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS IN OHMS, $\frac{1}{4}$ W, 1%

2. ALL CAPACITORS IN MICROFARADS.

3. A4, C11 & C12 INSTALLED FOR OPTION 5 ONLY (ML 952916-03) 5N1514; IN ALL UNITS 5N1514.

4. INSTALLED ONLY FOR >20KHz OPTION (ML 952916-02)



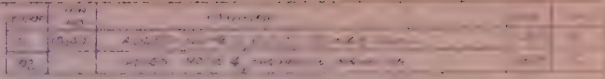


TABLE 4-3

IMPROPER OUTPUT FREQUENCIES

Step	Procedure	Result	Next Procedure
1	Switch 9514 to band on which improper frequencies occur. If on all bands, select 2-18 GHz. Use oscilloscope to monitor attenuator input voltages. Synchronize oscilloscope with Blanking signal for 6600.	a. Attenuator inputs are proper, as shown on schematic. b. Two or more voltages approach ground	a. Go to Step 2. b. Go to Step 3.
2	With same setup as Step 1, monitor tuning voltages, at the oscillators. Look for variations in linear ramps to YIG oscillators. VCO should receive curved sweep similar to Figure	a. Sweep is not proper shape, or it is offset. b. Sweeps are proper. c. Sweep timing is not proper.	a. Trace sweep back through Driver, checking against schematic. In VCO Driver, expect trouble in tuning voltage shaping circuit; diode or transistor. In YIG Driver, expect trouble in Osc. Driver Amplifier, emitter follower output transistor, Q16, or one or more of Band Slope Control FET's. Possible other band part is an isolating diode that feeds gate of FET. b. Suspect oscillator. Replace with known good oscillator. c. Check timing of pulses into 1B, 2B, 27B of Driver Board which supplies faulty sweep. If faulty, go to Step 3. If OK, replace faulty transistor or diode between these inputs and and FET outputs.

TABLE 4-3

IMPROPER OUTPUT FREQUENCIES (CONTINUED)

Step	Procedure	Result	Next Procedure
3	Trace timing pulses back through Bandswitch Logic Board A6. Start with terminals 2A, 3A, 4A, 5A, which are outputs to Driver Boards. Check also, terminals 1B, 2B, 3B, 4B, 33B, 34B, 35B, 36B, which are Oscillator selectors. Trace signals back to input 33A, the 0-10 volt ramp.	a. Input is proper timing within the circuit is faulty. b. Input Ramp is faulty.	a. Replace the integrated circuit which causes the faulty timing. b. Troubleshoot 6600 and intervening connections.

4-50. Amplifier U4 inverts the output of U3 and amplifies it by two, to give the VPF output.

4-51. When a band is chosen, such as band 7, a 5 volt positive voltage is applied to the input control terminal, in this case terminal 29 of the cable connector. The transistor Q12 saturates and removes +20 volts from the gates of FET's, Q6 and Q13. The other FET's have +20 volts applied through diodes, hence are cut off. With no cut-off bias on Q6 and Q13, they act as closed switches. Ramp voltage is applied to R15, thence through R44 to the inverting input of U3. Plus 10.5 volts is applied to R53. This supplies current through R52 to the inverting input of U3. The mixed input is amplified, and the output of U4 is a ramp from +2.0 volts to +18 volts, for band 7 (Full Band sweep from 2.0 GHz to 18.0 GHz).

4-52. The other band selecting circuits are identical except for resistor values which are selected to match output voltages to frequencies.

4-53. BANDSWITCH LOGIC A6

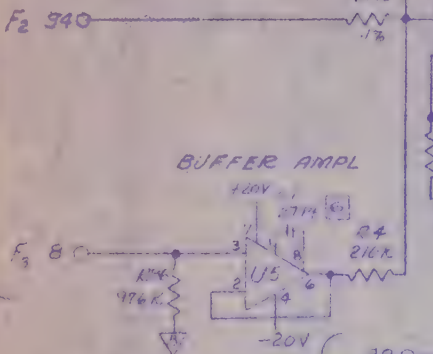
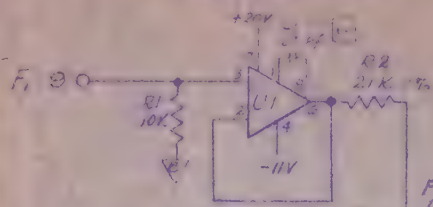
4-54. The Bandswitch Logic circuit provides timing for turning RF outputs ON and OFF, using the four channel PIN Diode Attenuator as a four pole switch. Seven level detectors are used to determine the timing for band 3 through 7. These detectors are U1 through U7.

4-55. Inputs to each level detector are the 0 to +10 volt tuning ramp, via pin 33A of A6, and a reference voltage set by potentiometers R4, R12, R20, R28, R36, R44, and R52. As the tuning ramp voltage passes through the reference voltage, the level detector output switches from +20 volts to -11 volts. Positive feedback is provided through the potentiometer circuit to increase speed of the crossover.

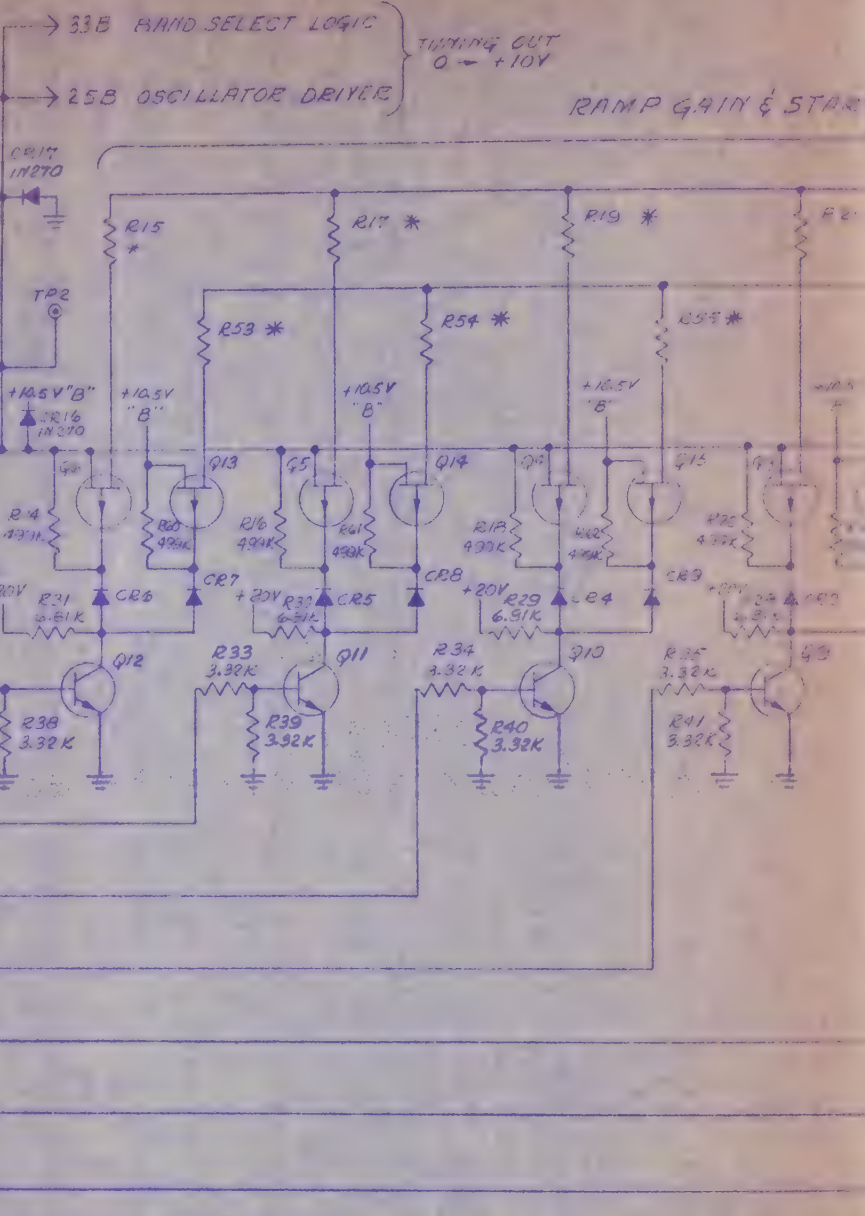
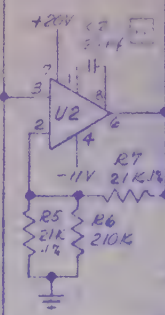
4-56. Output of the level detector circuit is limited by two diodes. Input to the following logic circuits may not be more positive than +5.7 volts or more negative than -0.7 volts. This protects the NAND gates which follow the level detectors.

FREQ CONTROL INPUTS (FROM G600)

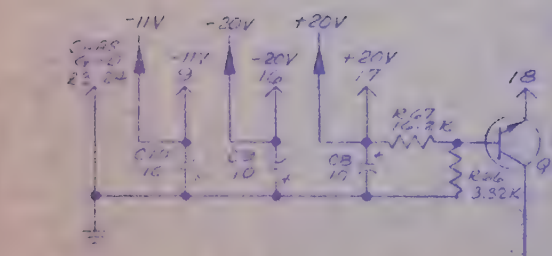
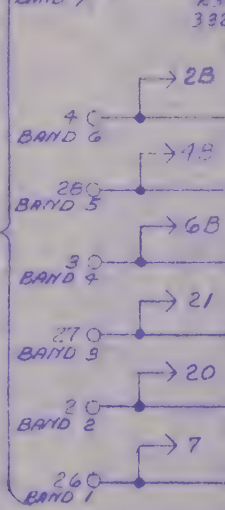
BUFFER AMPL



FREQ CONTROL (RAMP) SUMMING AMPLIFIER

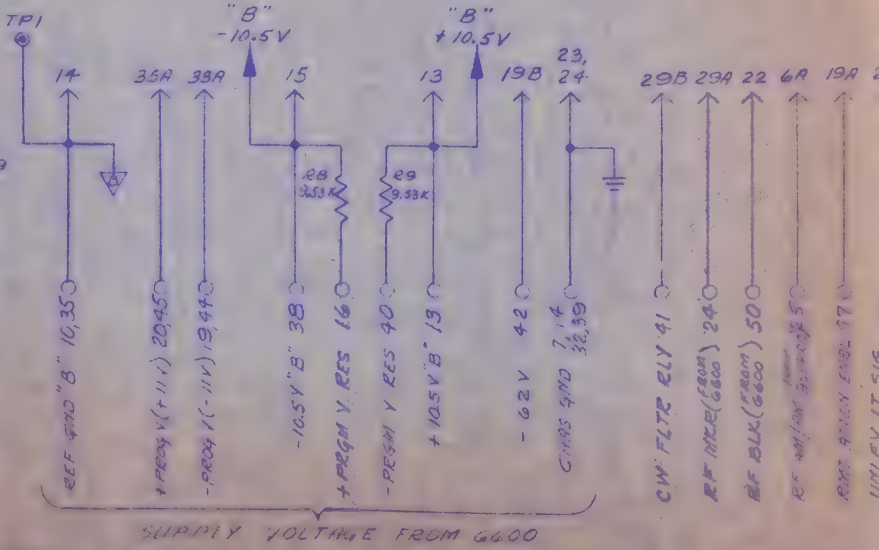


BAND SELECT INPUT (FROM 9514)



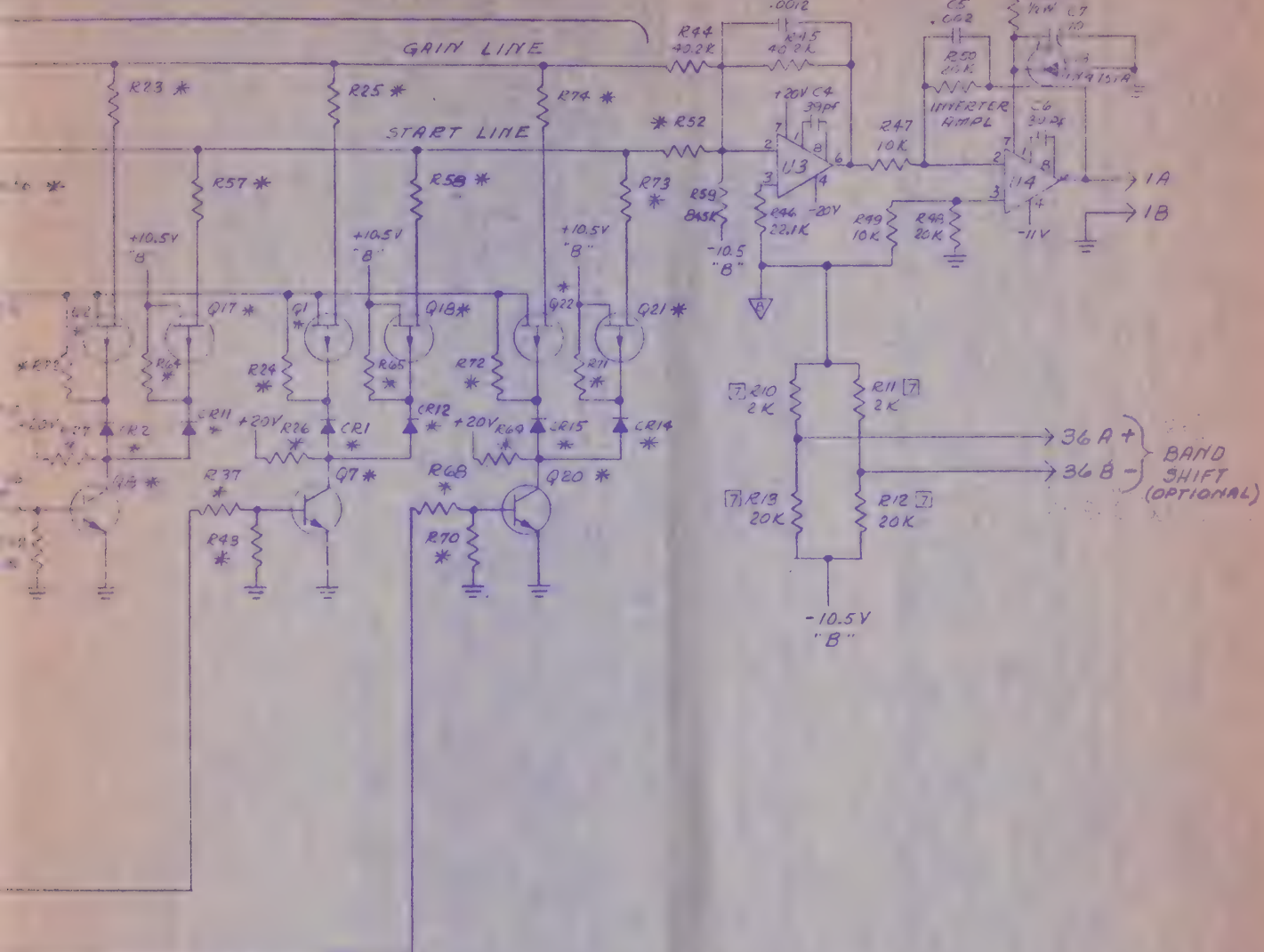
NOTES: UNLESS OTHERWISE SPECIFIED

- 1. ALL RESISTORS IN OHMS, 1/4W, 1%.
 - 2. ALL CAPACITORS IN MICROFARADS.
 - 3. REF DESIGNATOR TYPE NO.
- | REF DESIGNATOR | TYPE NO. |
|----------------|----------|
| U1-U2 | LM101A |
| U3-U4 | LM101A |
| U5-U6 | LM101A |



SUPPLY VOLTAGE FROM G600

ELECTION CKTS



NOTES: CONT'D.

4. SYM. DESIG.

50 PIN CONNECTOR TO INTERFACE PCB 103-3123-C01 WHICH MOUNTS CABLE CONNECTOR AND MODEL 9514 INTERFACE CABLE. THESE PINS NO'S ARE DERIVED THRU THE INTERFACE R.B. & ITS CONNECTOR & THRU THE INTERCONNECTING CABLE TO CONNECTOR J1 ON MODEL 9514 AS SHOWN ON SCHEMATIC 106-0812-C01.

12 FINGER PCB CONNECTION TO 9515 MOTHER BOARD (FINGERS 1-36 DUAL REMAIN EXCEPT WHERE A/B ARE SEPARATELY IDENTIFIED)

5. ALL COMPONENTS INSTALLED EXCEPT THOSE * NOTE TABLE ON SH12.

6. NOT INSTALLED WITH IC TYPE # TP-1319-01

7. INSTALLED PER BAND SHIFT OPTION

REF	DES	FIRST	LAST	NOT USED
U	1	1	1	16-95
R	1	1	1	
C	1	1	1	
Q	1	1	1	
W	1	1	1	

ITEM	REQD	PART NO	DESCRIPTION
LIST OF MATERIAL			
MATERIAL		DRAWN	DATE
		1/1/78	2-5-78
CHECK		SCHEMATIC, A5	
END		CONNECTOR PCB	
PROD		DIMENSIONS ARE IN INCHES	
FINISH OR TREATMENT		TOL. XX ± .015 XX ± .005 ANGLES IN DEGREES INDICATED OTHERWISE	
SCALE		NOTE	

103-3123-C01	9515
NEW ASSY	USED 100
ALFRED ELECTRONICS	
PALO ALTO, CALIFORNIA	
SIZE	106-0812-C01
SHEET	1 OF 1

SINGLE OCTAVE				B5,65		A5	C5		
DOUBLER OCTAVE		A	C		B,6			D	E
REF. DES.	STD. VALUE	-002	-003	-004	-005	-006	-007	-008	-009
R15		10K	10K	10K	10K	10K	10K	4.64K	6.38K
R17		40.2K	40.2K	102K	40.2K	102K	102K	40.2K	40.2K
R19		60.4K	60.4K	143K	60.4K	143K	143K	60.4K	60.4K
R21		93.1K	93.1K	162K	93.1K	162K	162K	93.1K	93.1K
R22,64	499K			X		X	X	X	X
R23				357K		357K	357K	165K	276K
R24,65	499K	X	X			X	X		
R25		2.15K	2.15K			1.33K	1.33K		
R26	6.81K	X	X			X	X		
R27	6.81K			X		X	X	X	X
R35,42	3.32K			X		X	X	X	X
R37,43	3.32K	X	X			X	X		
R52		80.6K	80.6K	40.2K	80.6K	40.2K	40.2K	40.2K	40.2K
R53		200K	200K	243K	200K	243K	243K	715K	340K
R54		12.4K	12.4K	22.1K	12.4K	22.1K	22.1K	41.2K	41.2K
R55		86.6K	86.6K	52.3K	86.6K	52.3K	52.3K	115K	115K
R56		200K	200K	127K	200K	127K	127K	226K	226K
R57				243K		243K	243K	715K	340K
R58		340K	340K			383K	383K		
R68,70	3.32K		X				X		
R69	6.81K		X				X		
R71,72	4.3K		X				X		
R73			340K				383K		
R74			2.15K				2.15K		
Q2,17	B-175			X		X	X	X	X
Q7	2N3904	X	X			X	X		
Q8	2N3904			X		X	X	X	X
Q20	2N3904		X				X		
Q21,22	B-175		X				X		
CR1,12	1N4148	X	X			X	X		
CR2,11	1N4148			X		X	X	X	X
CR14,15	1N4148		X				X		
Q1,18	E-175	X	X			X	X		

PC	PS
11	-012
4.68K	6.78K
100K	102K
143K	143K
162K	162K
X	X
222K	359K
X	X
268K	2.15K
X	X
X	X
X	X
X	X
52.3K	52.3K
715K	715K
22.1K	22.1K
52.3K	52.3K
127K	127K
244K	244K
374K	374K
	X
	X
	X
	174K
	2.15K
X	X
X	X
X	X
	X
	X
X	X
X	X
	X
X	X

PARTS LIST			
OWN BY		MATERIAL	MATERIAL SYMBOL NO.
CHECK		FINISH	
PR. ENG.			
DRAFT. SUPV.		WEIGHT	SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND TOLERANCES ARE XX .XX .XX ANGLE 2.519 ±.005 21°		TITLE SCHEMATIC, A5 CONNECTOR PCB	
DO NOT SCALE DWG.		CODE IDENT	SHEET 1 OF 2
		THE SINGER COMPANY PALO ALTO OPERATION PALO ALTO, CALIFORNIA SIZE DWG NO. 106-0841-001 03	

4-57. If Band 7 is chosen, band 7 Enable signal at pin 55A is +5 volts. Other enable signals are at ground potential.

4-58. Tracing through Band 6, pin 3 of U11 will be +5 volts. Pin 6 of U11 will be +5 volts because of the ground input to pin 5. Pin 10 of U10 will be at ground, hence the 8 - 12 GHz oscillator signal will not be turned ON by this circuit. Pin 12 of U10 will be at ground, so the 12 - 18 GHz oscillator signal will not be turned ON by this circuit. Pin 6 of U11 is connected to pin 9 of U11. The +5 volts applied allows the output from pin 8 to be controlled by the circuit driven by U7. For Bands 3, 4, 5, and 6, the situation is the same. No RF signals are turned ON, and control of the attenuator channels is given to the Band 7 circuits.

4-59. The +5 volt Band 7 Enable signal allows the gates on the outputs of U5, U6, and U7 to be controlled by U5, U6, and U7. At start of the tuning ramp, ramp potential is zero. Outputs of U5, U6, and U7 are +5 volts, hence pins 3 and 6 of U12 and pin 11 of U11 are at ground.

4-60. Pin 10 of U15 is at +5 volts, so the 2 - 4 GHz oscillator selection circuit is turned ON. Pin 12 of U14 is at +5 volts, so pin 8 of U15 is at ground and the 4 - 8 GHz oscillator selection circuit is not turned ON. Pin 12 of U13 is at +5 volts, so pin 6 of U15 is at ground, and the 8 - 12 GHz oscillator selection circuit is not turned ON. Pin 2 of U15, in the output of U7 is at ground, so pin 11 of U11 is at +5 volts and pin 4 of U15 is at ground. Hence the 12 - 18 GHz oscillator selection circuit is not turned ON.

4-61. As the tuning ramp voltage reaches 1.25 volts, the frequency of the 2 - 4 GHz oscillator reaches 4.000 GHz. At this time, U5 switches over, since the reference voltage set by R36 is 1.25 volts. Pin 6 of U5 is then negative, and pin 1 of U12 goes just below ground. This gives +5 volts at pin 3 of U12 and ground at pin 10 of U15, hence the 2 - 4 GHz oscillator selection circuit is no longer turned ON. At the same time this puts +5 volts on

pin 13 of U14. Pins 1 and 2 of U14 are at +5 volts because of the Band 7 Enable signal and the output of U6. Hence pin 12 of U14 goes to ground potential. This puts +5 volts on pin 8 of U15, and the 4 - 8 GHz Oscillator selection circuit is turned ON.

4-62. As 2 - 4 GHz selection is turned OFF and 4 - 8 GHz selection is turned ON, pin 5 of U14 is driven positive by pin 3 of U12, so pin 6 of U14 goes to ground potential, and the 2 - 4 GHz signal is cut OFF by the attenuator. Pin 11 of U14 is driven to ground by U14, pin 12, so pin 8 of U14 goes to +5 volts, and the attenuator turns ON the 4 - 8 GHz signal. The 4 - 8 GHz oscillator is operating at 4.000 GHz as it is turned ON, so there is no shift in frequency as the crossover is accomplished, and frequency increases with time at the same rate as before.

4-63. As the tuning ramp voltage reaches 3.75, the 4 - 8 GHz oscillator frequency reaches 8.000 GHz. The level detector, U6, switches its output to negative, and the input at pin 5 of U12 goes to ground. This ground signal also goes to pin 2 of U14; hence pin 12 of U14 goes to +5 volts so that pin 8 of U15 goes to ground, and the 4 - 8 GHz oscillator selection circuit is turned OFF. The ground signal at pin 5 of U12 drives the output to +5 volts at pin 6. This makes the inputs on pins 1, 2, and 13 of U13 all +5 volts, so pin 12 of U13 goes to ground. This causes pin 6 of U15 to go to +5 volts, and the 8 - 12 GHz oscillator selection circuit is turned ON.

4-64. As the selection circuits are turned OFF and ON, the +5 volt signal into pin 11 of U14 causes pin 8 to go to ground potential and the attenuator cuts OFF the RF from the 4 - 8 GHz oscillator. Pin 12 of U13 goes to ground potential, so pin 11 of U13 does also. This drives pin 8 of U13 to +5 volts so that the attenuator turns ON the RF from the 8 - 12 GHz oscillator.

4-65. When the tuning ramp voltage reaches 6.25, level detector U7 switches its output to negative. Pin 1 of U15 goes to ground potential, pin 2 of U15 goes to +5 volts, and

pin 11 of U11 goes to ground potential. This causes pin 4 of U15 to go to +5 V and turn ON the 12 - 18 GHz oscillator selection circuit.

4-66. Pin 11 of U11 is connected to pin 13 of U13, so the ground potential causes pin 12 of U13 to go to +5 volts. This causes pin 6 of U15 to go to ground potential and the 8 - 12 GHz oscillator selection circuit is cut OFF.

4-67. Pin 11 of U13 is connected to pin 12 of U13, so pin 8 goes to ground potential, and the attenuator cuts OFF the RF from the 8 - 12 GHz oscillator. Pin 10 of U11 is connected to pin 11 of U11, so the ground potential causes pin 8 of U11 to go to +5 volts. This causes the attenuator to turn ON the RF from the 12 - 18 GHz oscillator.

4-68. When the tuning ramp reaches +10 volts, it resets to ground potential and all circuits in the Bandswitch Logic reset to the conditions described for start of sweep.

4-69. Since there is positive feedback on the level detectors, the crossover time is not exactly the same for an upward ramp as for a downward ramp. However, there is sufficient overlap of frequencies at each end of the oscillator tuning ranges that a continuous frequency sweep is provided in both directions.

4-70. The frequency sweep is stopped for 2 milliseconds at oscillator changeover to allow the oscillators to stabilize to the suddenly applied tuning current through the YIG tuning coils. This delay is accomplished by a One Shot, U17, which drives the Remote Ramp Control circuit in the 6600. The one shot timing is started by a ground pulse at pin 8 of U12. This occurs when pin 8 of U16 changes in either direction between ground and +5 volts. A negative change passes through C1 as a short pulse, grounding pin 13 of U12. This causes pin 11 to go to +5 volts, and it causes pin 8 to go to ground potential unless BLANK IN on pin 22A of A6 is at ground potential, which holds pin 8 of U12 at +5 volts.

4-71. Similarly, a positive change is inverted between pin 13 and pin 12 of U15 so that a negative pulse is passed by C2. This pulse is inverted and reinverted from pin 12 to pin 8 of U12, to drive the One Shot, U17.

4-72. Table 4- shows voltages on pins of logic elements from the level detectors to the output of U16 for the various stages of frequency sweep. When the voltage on pin 8 of U16 changes as the tuning ramp goes into another voltage stage, the 2 millisecond one shot is triggered as explained in the preceding paragraphs. A 1 symbol indicates +5 volts; a 0 symbol indicates ground potential.

4-73. Other bands use similar logic for turning signals ON and OFF and for producing the 2 millisecond delay on crossover. Note that on the 8 input U16 gate, all inputs except for the band in use are at +5 volts. This allows complete control by the circuits of the band in use.

4-74. Bands 1 and 2 are controlled by relays K1 and K2. Band 1 Enable applies +5 volts to pin 7 of the A6 connector. This turns ON Q1 and Q2 which close the contacts on K1 and K2. If Band 1 is not enabled, pin 7 is at ground potential, so relay K1 cannot be energized. Band 2 Enable applies +5 volts to pin 20 of the A6 connector. This turns ON Q2, which closes the contacts of K2. Band 3 Enable applies +5 volts to pin 21 of the A6 connector. This turns ON Q2, which closes the contacts of K2.

4-75. Relay K1 is operated by Band 1 only. Relay K2 is operated by Bands 1, 2, and 3. Transistors Q3 through Q7 form a switch which is operated by U1 when Band 3 is enabled. Normal output to pin 18B of the A6 connector is +5 volts. When Band 3 is enabled, pin 18B is driven to ground potential as the tuning ramp voltage exceeds the reference voltage of U1.

4-76. FREQUENCY MODULATION CIRCUITS, A2

4-77. The incoming FM signal is applied to pin 3 of the A2 connector. This signal goes out to the 4 - 8 GHz voltage tuned oscillator via pin 35, without modification.

4-78. For YIG tuned oscillators, two amplifiers are used. Transistors Q1 through Q7 form an amplifier which delivers current via pins 21B, 22B, 25B, 26B, 28B, 29B to the Ku Band, X Band, and C Band FM coils. Transistors Q8 through Q14 form a similar amplifier which delivers current via pins 21A, 22A, 25A, 26A, 28A, 29A to the S Band, L Band, and spare FM coils.

TABLE 4-4

LOGIC ELEMENT CONDITIONS FOR BAND 7
IN DRIVE CIRCUIT FOR 2 MILLISECOND ONE SHOT

Frequency in GHz	Ramp Voltage	Band 7 Enable	Pin 6 of U5	Pin 6 of U6	Pin 6 of U7	Pin 3 of U12	Pin 6 of U12	Pin 2 of U15	Pin 11 of U11	Pin 12 of U14	Pin 12 of U13	Pin 5 of U13	Pin 4 of U13	Pin 3 of U13	Pin 6 of U13	Pin 8 of U16
2 - 4	0-1.25	1	1	1	1	0	0	0	1	1	1	1	0	1	1	0
4 - 8	1.25 - 3.75	1	0	1	1	1	0	0	1	0	1	1	1	1	0	1
8 - 12	3.75 - 6.25	1	0	0	1	1	1	0	1	1	0	1	1	0	1	0
12 - 16	6.25 - 10	1	0	0	0	1	1	1	0	1	1	1	1	1	0	1
2 - 4	0-1.25	1	1	1	1	0	0	0	1	1	1	1	0	1	1	0

- NOTES: UNLESS OTHERWISE SPECIFIED
 1. 16 PIN IC TEST SOCKET
 2. DIODES ARE 1N4148
 3. CAPACITORS ARE IN MICROFARADS
 4. U8-U17 PIN 14 TO +5V
 PIN 7 TO GND
 5. SYSTEM LOGIC MODE
 1= BAND SELECTED
 0= BAND OFF
 6. RESISTORS ARE IN OHMS, $\frac{1}{4}$ W, 1%

7. R60, R62, Q2, X2, CR17, CR18 ARE INSTALLED ONLY FOR BAND 2
 (1-2.5GHZ) (-002 ASSY ONLY)
 8. R57-R59, G1, K1, CR15-CR18, R60, R62, Q2, X2 INSTALLED ONLY FOR BAND 1
 (0.1-2.5GHZ) (-003 ASSY ONLY)
 9. R1, R8, R61, U1, U8, CR1, CR2, R63-R69, Q3-Q7 ARE INSTALLED ONLY FOR BAND 3
 (FREQ SPCL) (-004 ASSY ONLY)

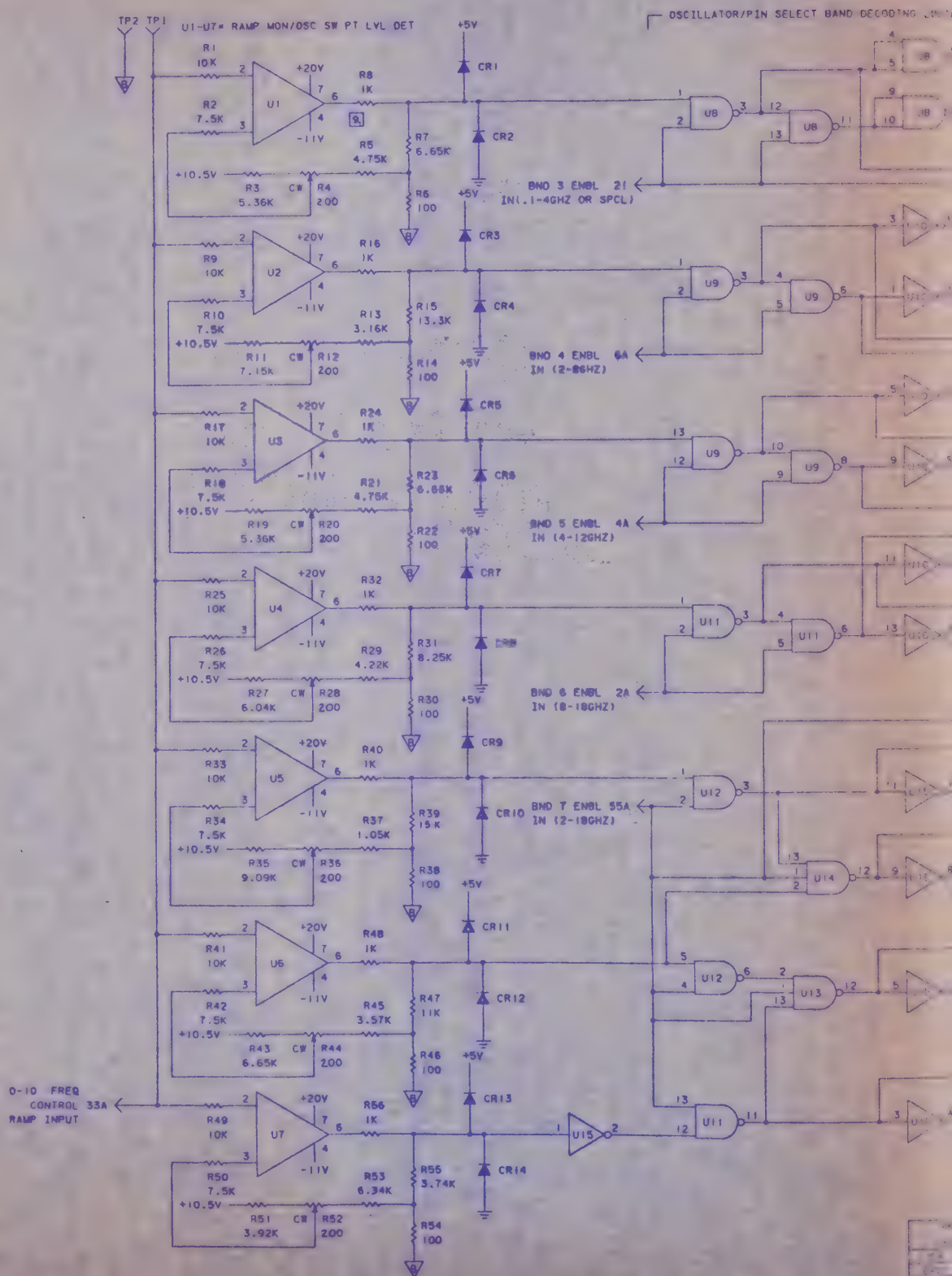


TABLE 4-5

IMPROPER FREQUENCY MODULATION

Step	Procedure	Result	Next Procedure
1	Check for FM input to FM jack on rear panel. Should be ± 10 volts (maximum).	a. ± 10 volts present. b. FM signal very low, distorted, or no input.	a. Go to Step 2. b. Correct source of modulation.
2	Check for FM input at pin 3 of A2.	a. ± 10 volts present. b. FM signal very low, distorted, or not present.	a. Go to Step 3. b. Look for broken wire between input jack and terminal by pin 3 of A2, on Mother Board.
3	Check for FM signal at pins 29B and 29F of A2. Signals should be ± 1.5 volts for ± 10 volts at input jack.	a. Signals are proper. b. No or distorted or very low signals.	a. Trouble is in YIG oscillator. Return to factory for repairs. b. Go to Step 4.
4	Check for signals at pins 21B and 21F of A2.	a. Signals swing to almost ± 20 volts. b. Little, or distorted, or no signals appear.	a. FM coil is open. Check for coil continuity. Return bad oscillator for repair. b. Go to Step 5.
5	Trace signals from input through transistor B of dual transistor, the Level Shifter, and the current amplifier.		Replace parts which cause signals to disappear or distort.

4-79. The FM input signal goes to the base of Q6B. Feedback of voltage across R41 goes to the base of Q6A. The FM coils current flows through R41, so that current through the coils is held directly proportionate to the input FM signal voltage.

4-80. Outputs from the collectors of Q6 drive the differential level shifters Q4 and Q5. Q3 acts as a constant current source for Q4. Q1 and Q2 are push-pull emitter followers which supply current to the FM coils. Gain of the circuit is sufficient to hold proportionality to $\pm 1\%$.

4-81. Signal flow through transistors Q8 through Q14 is exactly like that through Q1 through Q7.

4-82. VCO DRIVER, A9

4-83. The VCO driver, A9, controls the frequency sweep of the 4 - 8 GHz voltage controlled oscillator.

4-84. The tuning input voltage ramp is turned ON and OFF by FET's Q5, Q6, and Q7. Rate of voltage increase at the output to the oscillator is determined by controls R23, R28, and R29. Starting voltage of the ramp is determined by R36, R40, and R44, starting voltage being turned on by FET's Q9, Q10, and Q11. Q1, Q2, and Q3 control the FET switches, which are cut OFF by positive voltages on their gates. If Q1, Q2, and Q3 are cut OFF by ground potentials at pins 1B, 2B, and 27B of the A9 connector, all of the FET's except Q8 are out OFF. Q8 supplies steady voltage to hold the oscillator at the low frequency end of the band. When Q1, Q2, or Q3 conducts, its collector current comes partly from the base of Q4. This turns ON Q4 so that FET Q8 is cut OFF by positive voltage at the gate, and the proper sweep starting voltage is supplied by Q9, Q10, or Q11.

4-85. Currents through the FET's are converted into proper voltages at the output to the oscillator by the operational amplifier U2, impedance changer Q12, emitter follower Q15, and two constant current supplies, Q13 and Q14. CR9, CR11, and CR12 are protective diodes;

they do not normally carry any current. Negative feedback from the output to pin 2 of U2 goes back through R54, is partly shunted to +10.5 volts and -10.5 volts by the tuning voltage shaping circuit, and is then fed back through R53. A steady bias current is fed through R51 and R52 from -10.5 volts.

4-86. Current is fed through R32 from an optional frequency offset signal, R31 from the tuning ramp, R48 from the starting voltage gates, R51 from -10.5 volts, and R53 from the tuning voltage shaping circuit, which gets current from the output of Q13 and Q15.

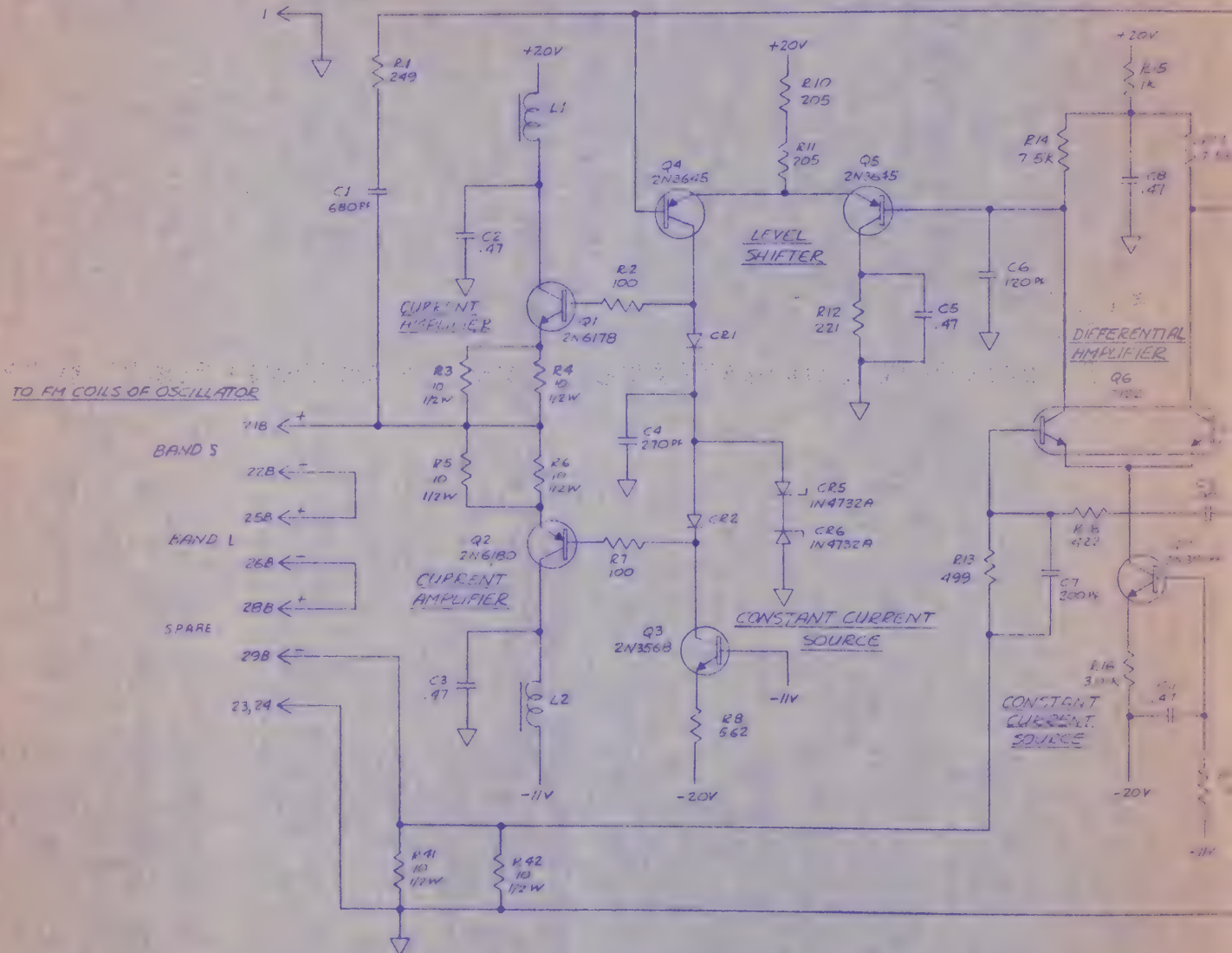
4-87. If the voltage at pin 2 of U2 is more than about 2 millivolts from ground, pin 6 of U2 will be at one of the supply voltages, +20 or -11. Feedback through R53 is negative, so voltage at pin 2 is held close to ground, and the sum of all currents to that point must be zero. This means that the voltage at pin 6 is directly proportional to the sum of the currents through R32, R31, and R48, but of opposite polarity, and affected by the currents to and from the tuning voltage shaping circuit.

4-88. As an example of how the shaping circuit operates, see Q20, in the middle of the shaping circuit. The currents to pin 2 of U2 from the gating FET's is a negative going linear ramp. This means a positive going linear ramp at pin 6 of U2, with the current through R53 adding to the other currents into and out of pin 2 to form a net current of zero.

4-89. Without the shaping circuit, feedback current is proportional to output voltage, so the output is a linear ramp. With the shaping circuit, however, if output voltage is low, current flows through CR17, and R95 determines how much current flows. The emitter of Q20 is held at an essentially constant voltage by the voltage on the base of Q20, which is set by R92. Hence voltage across R95 varies as the tuning ramp voltage changes. Changing output voltage causes changing current in R95, hence less current change in R53 than would occur if R95 drew no current. Hence rate of voltage change at the output is greater than for non-shunted feedback. When the voltage at the anode of CR17 reaches the voltage at the emitter of Q20, current through CR17 stops and does not resume until the ramp voltage goes back negative. At this

1. ALL DIODES IN 414B
2. ALL DIODES IN 414B
3. ALL DIODES IN 414B
4. ALL INDUCTORS L1-L8 ARE 22-39
5. IF C BAND OSC IS YIG INSTALL VALVES IN () FOR C13 & C15
6. CONNECTORS HAVING NO A/B SUFFIX SHOWN ARE CONNECTED BOTH SIDES

FM IN 3 ←

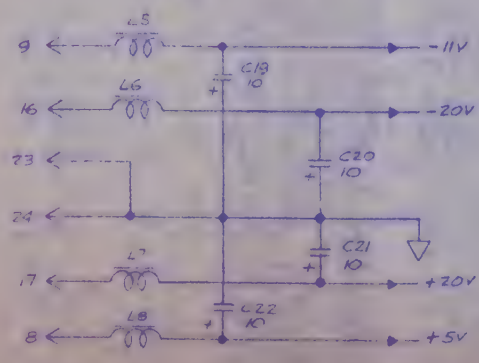


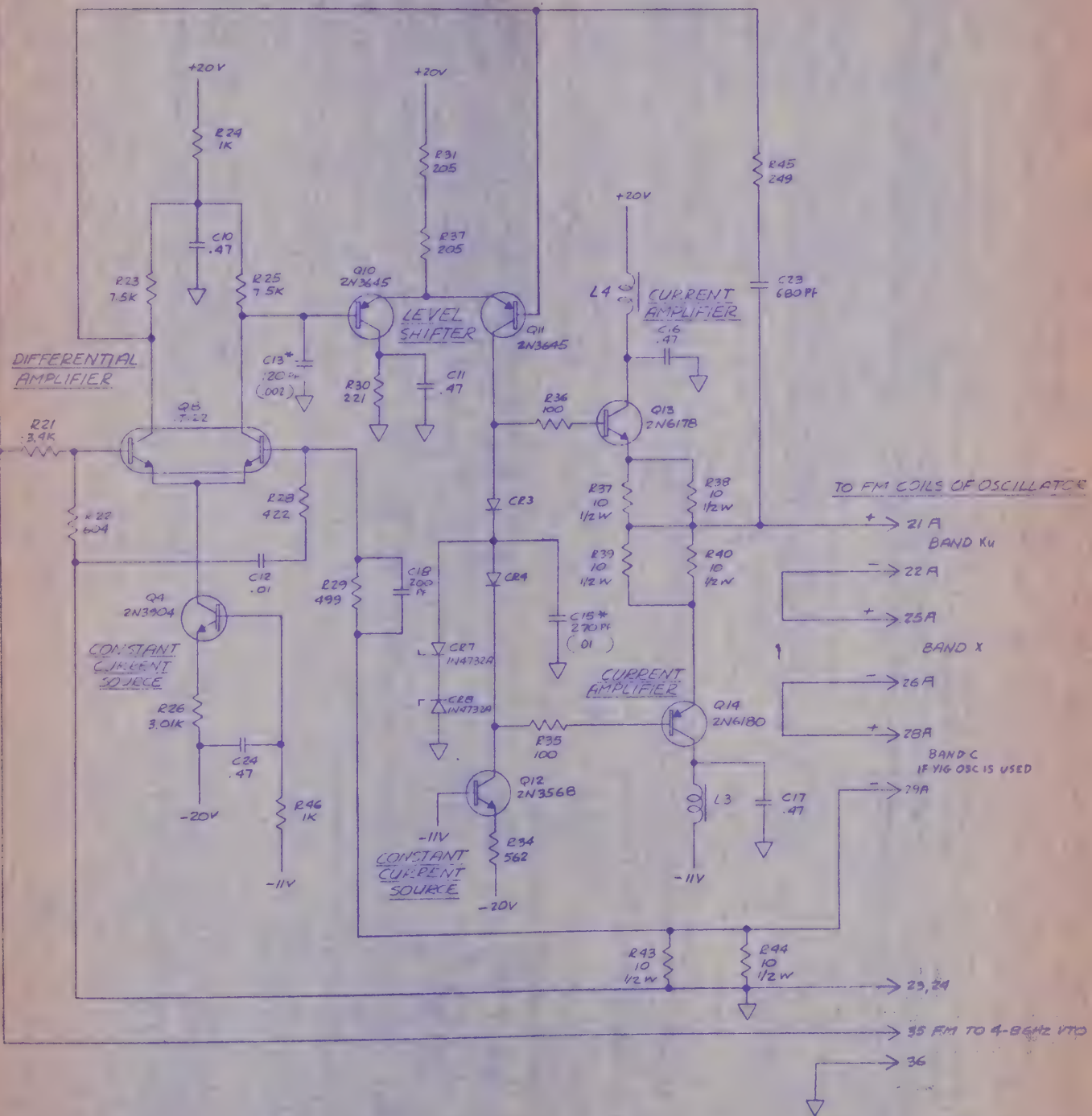
TO FM COILS OF OSCILLATOR

BAND 5

BAND 1

SPARE





ITEM	REQD	PART NO	DESCRIPTION
LIST OF MATERIAL			
MATERIAL	DRAWN FL	DATE	
	CHECK	1-15-72	
	ENG		
MATERIAL STOCK NO	PROD		
FINISH OR TREATMENT	SCALE		

**SCHMATIC
FM MODULATION
AMPLIFIER**

DIMENSIONS ARE IN INCHES
TOL XX - .015 XXX - .005 ANGLE ± 1/2°
UNLESS INDICATED OTHERWISE

103-3-13	10-5-72
NEXT ASSY	USED ON
ALFRED ELECTRONICS	
PALO ALTO, CALIFORNIA	
SIZE D	REV.
106-0823-001	
SHEET 1	OF 1

point, ignoring all other shunt paths, the rate of voltage change becomes what it would be for a non-shunted feedback.

4-90. Each of the ten shunt circuits has an adjusting potentiometer for setting voltage when current starts or stops. Each has a factory-selected resistor, like R95, which determines current, hence output voltage rate of change. These shunts allow the shape of the output voltage ramp to match the tuning characteristics of the voltage controlled oscillator.

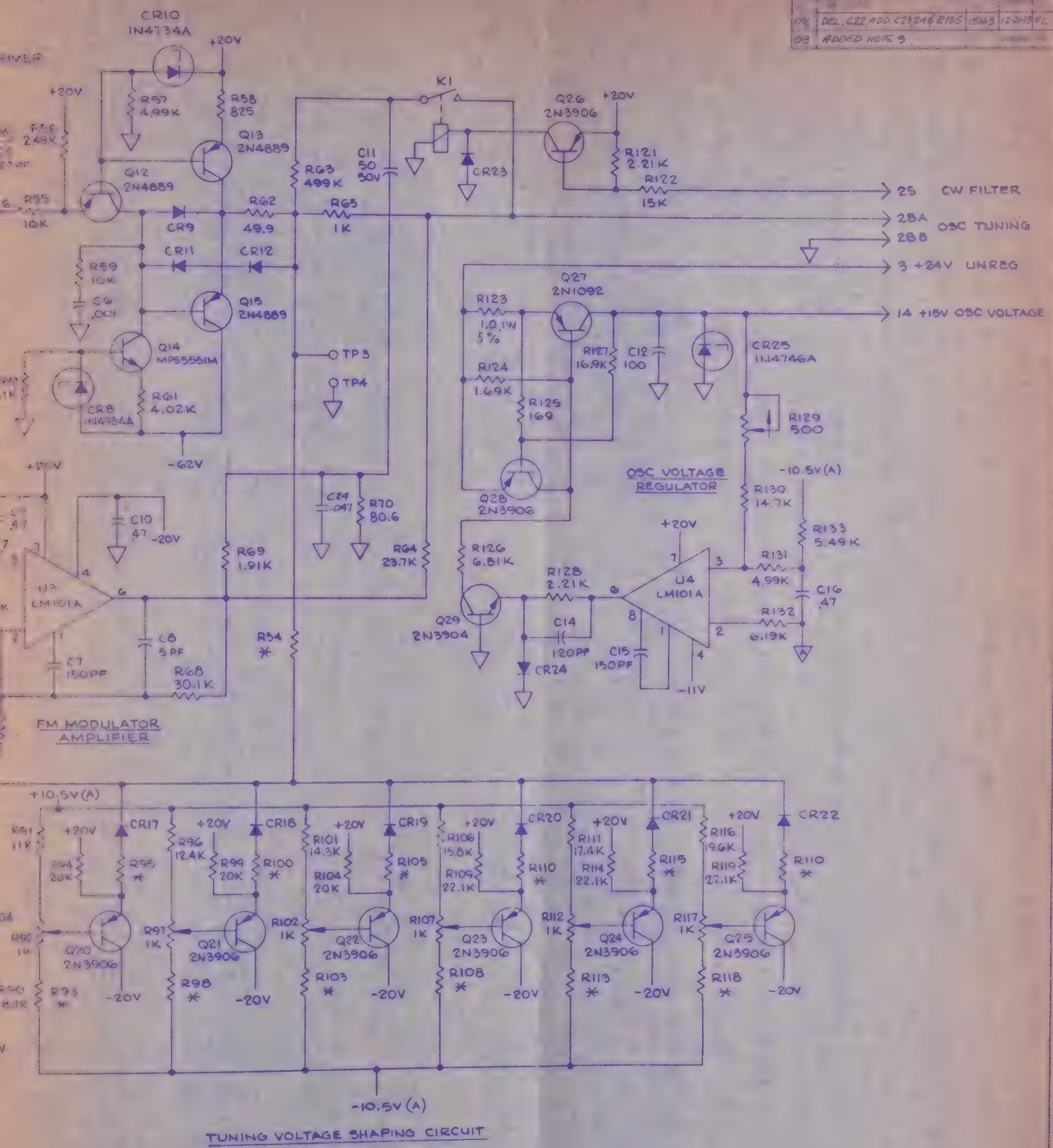
4-91. FM is provided by U3. The FM input signal from pin 26A of the A9 connector is amplified by 1.5 between the input at pin 26A and pin 6 of U3. For a ± 10 volt input, output is ± 15 volts. R69 and R70 form a voltage divider, reducing the voltage swing at C11 to ± 0.6 volts. Resistor R63 keeps the output side of C11 at approximately output voltage, to prevent sudden surges when the contacts of K1 are closed. With contacts closed, the reduced FM signal is imposed on the tuning ramp voltage to cause Frequency Modulation of the oscillator.

4-92. U4 compares oscillator voltage at pin 14 of the A9 connector with a -10.5 volt reference. Output of U4 is fed through Q29 to the series regulator Q27, which therefore holds output voltage to a value set by R129. Q28 limits current by reducing base current in Q27 if current through R123 is excessive. CR25, a Zener diode, protects the oscillator against excess voltage.

4-93. YIG DRIVERS, A8, A10, A11.

4-94. The YIG drivers, A8, A10, A11, control the frequency sweeps of the 2 - 4 GHz, 8 - 12 GHz, and 12 - 18 GHz voltage controlled oscillators.

4-95. The tuning input voltage ramp is turned ON and OFF by FET's Q1, Q2, and Q3. Rate of voltage increase at the output to the oscillator is determined by controls R9, R12 and R15. Starting voltage of the ramp is determined by R30, R33, and R36, starting voltage being turned on by FET's Q9, Q10, and Q11. Q5, Q6, and Q7 control the FET switches, which are cut OFF by positive voltages on their gates. If Q5, Q6, and Q7 are cut OFF by ground potentials at the band control inputs to their bases, all of the FET's except Q8 are cut OFF.



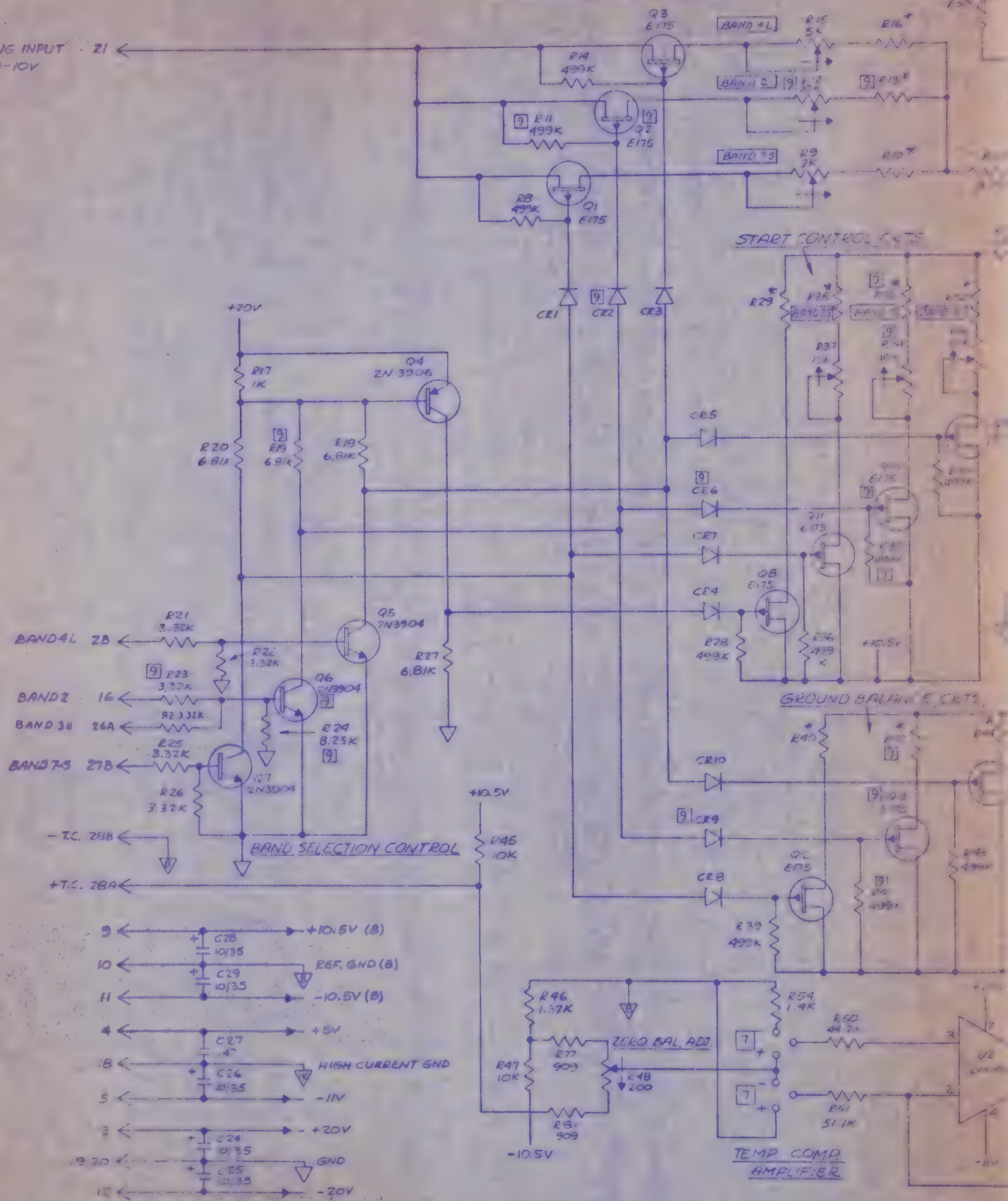
02	DEL, C22, MOD, C23, 24, R135	15163	12/21/81
03	ADDED NOTE 3		

ITEM	REQD	PART NO.	DESCRIPTION	103-3117-001	9515
LIST OF MATERIAL				NEXT ASSY	USED ON
MATERIAL		DRAWN	DATE	SCHEMATIC DIAGRAM, 4-8 GHz VCO DRIVER	
		CHECK	15 JAN 73		
		ENG			
MATERIAL STOCK NO		PROD			
FINISH OR TREATMENT		SCALE			
DIMENSIONS ARE IN INCHES TOL XX ± 0.15 XXX - 005 ANGLE - W UNLESS INDICATED OTHERWISE				SIZE	REV
				D 106-0822	103
				SHEET	OF
				1	1

BAND SHIFT 24

BAND SLOPE CONTROL

TUNING INPUT 21
0-10V



NOTES: UNLESS SPECIFIED OTHERWISE:

1. ALL RESISTORS IN OHMS 1/4W, 1%

2. ALL CAPACITORS IN MICROFARADS

3. ALL DIODES IN 4148

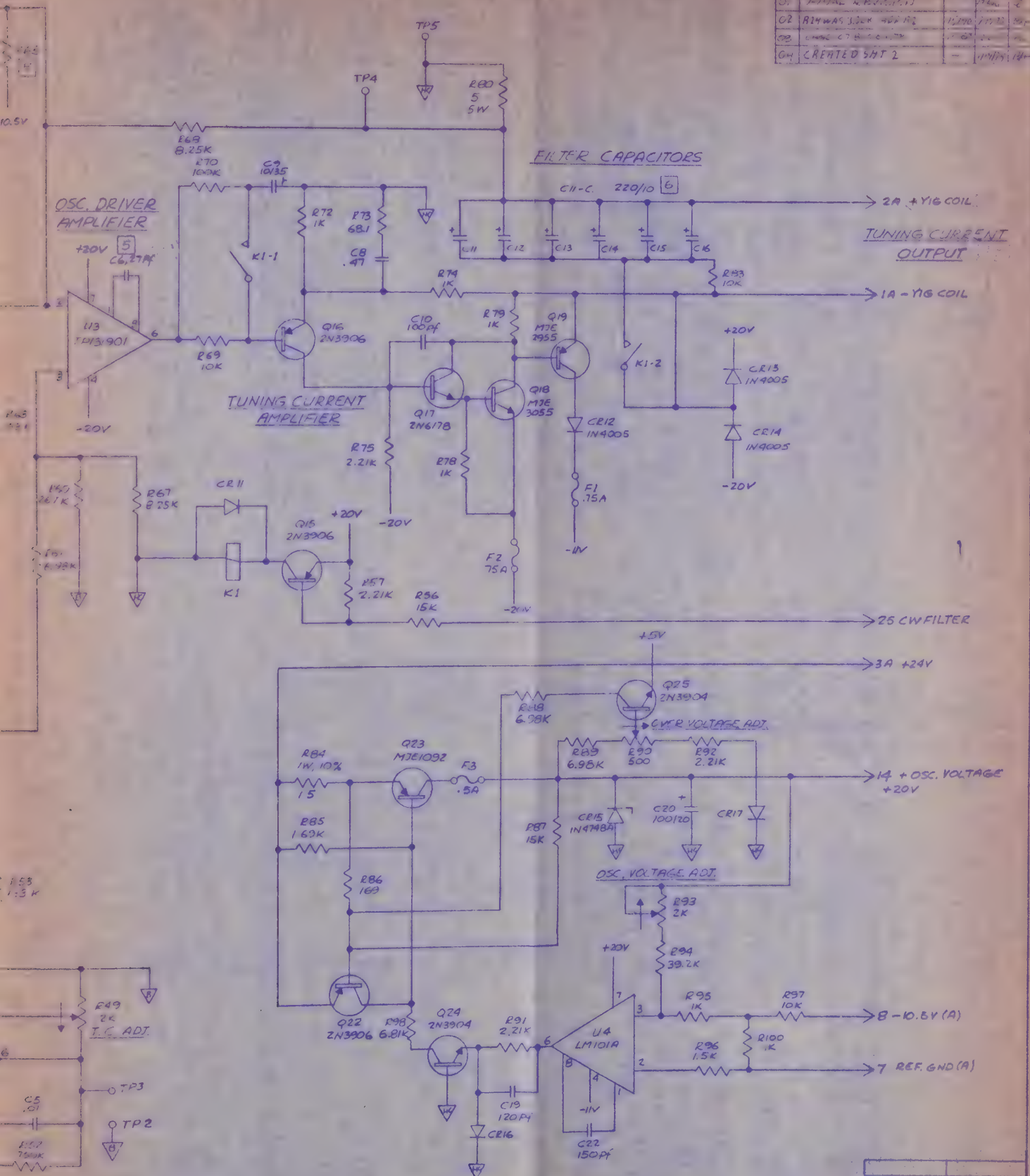
4. * FACTORY SELECT (SEE TABLE)

5. NOT INSTALLED WITH INTERNALLY COMPENSATED IC

6. * FACTORY SELECT (SEE TABLE)

7. * FACTORY SELECT (SEE TABLE)

8. * FACTORY SELECT (SEE TABLE)



ITEM	REQD	PART NO	DESCRIPTION		103-3115-001 -001	9515 A1B -001
LIST OF MATERIAL					NEXT ASSY	USED ON
MATERIAL		DRAWN FL	DATE 1-9-78	SCHEMATIC VIB DRIVER, 1-4GHZ	ALFRED ELECTRONICS PALO ALTO, CAL FORNIA	
		CHGR				
		ENG				
MATERIAL STOCK NO		PROD				
FINISH OR TREATMENT			DIMENSIONS ARE IN INCHES TOL XX ± .015 XX ± .005 ANGLES 90° UNLESS INDICATED OTHERWISE		SIZE D	REV 1
SCALE						

74.4 A	95.15 G, B	75.1 A	75.1 G, B	75.15 A
R3 =				
R91 =				
R10 = $\left(\frac{2.063}{I_3 - I_1} - 9.06 \right)$	$= \left(\frac{2.063}{I_3 - I_1} - 9.06 \right)$	$= \left(\frac{2.063}{I_3 - I_1} - 9.06 \right)$	$= \left(\frac{2.063}{I_3 - I_1} - 9.06 \right)$	$= \left(\frac{2.063}{I_3 - I_1} - 9.06 \right)$
R13 = $\left(\frac{16.5}{I_3 - I_2} - 10.56 \right)$	$= \left(\frac{16.5}{I_3 - I_2} - 10.56 \right)$	$= \left(\frac{16.5}{I_3 - I_2} - 10.56 \right)$	$= \left(\frac{16.5}{I_3 - I_2} - 10.56 \right)$	$= \left(\frac{16.5}{I_3 - I_2} - 10.56 \right)$
R16 = $\left(\frac{5.495}{I_3 - I_1} - 10.56 \right)$	$= \left(\frac{5.495}{I_3 - I_1} - 10.56 \right)$	$= \left(\frac{5.495}{I_3 - I_1} - 10.56 \right)$	$= \left(\frac{5.495}{I_3 - I_1} - 10.56 \right)$	$= \left(\frac{5.495}{I_3 - I_1} - 10.56 \right)$
R24 = $\left(\frac{17.495}{I_1} - 69.8 \right)$	$= \left(\frac{17.495}{I_1} - 69.8 \right)$	$= \left(\frac{17.495}{I_1} - 69.8 \right)$	$= \left(\frac{17.495}{I_1} - 69.8 \right)$	$= \left(\frac{17.495}{I_1} - 69.8 \right)$
R5 =				
R93 =				
R32 = $\left(\frac{17.325}{I_1} - 74.8 \right)$	$= \left(\frac{17.325}{I_1} - 74.8 \right)$	$= \left(\frac{17.325}{I_1} - 74.8 \right)$	$= \left(\frac{17.325}{I_1} - 74.8 \right)$	$= \left(\frac{17.325}{I_1} - 74.8 \right)$
R35 = $\left(\frac{17.325}{I_2} - 74.8 \right)$	$= \left(\frac{17.325}{I_2} - 74.8 \right)$	$= \left(\frac{17.325}{I_2} - 74.8 \right)$	$= \left(\frac{17.325}{I_2} - 74.8 \right)$	$= \left(\frac{17.325}{I_2} - 74.8 \right)$
R38 = R32	= R32	= R32	= R32	= R32
R6 =				
R94 =				
R70 = $\left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$
R42 = $\left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$
R44 = $\left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$	$= \left[\frac{(R1 + R2)(R3 + R4)}{(R1 + R2)(R3 + R4)} - 6.98 \right]$

I_1 = MAGNET CURRENT @ 2.0 GHz
 I_2 = MAGNET CURRENT @ 2.3 GHz
 I_3 = MAGNET CURRENT @ 4.0 GHz
 I_4 = MAGNET CURRENT @ 4.2 GHz
 I_5 = MAGNET CURRENT @ 2.2 GHz
 I_6 = MAGNET CURRENT @ 2.4 GHz

CURRENT IN AMPS
 RESISTANCE IN OHMS

251.588

$$= \left(\frac{1.04}{I_1} - 7.06 \right)$$

$$= \left(\frac{16.5}{I_1} - 10.58 \right)$$

$$= \left(\frac{17.4}{I_1} - 69.0 \right)$$

$$= \left(\frac{17.83}{I_1} - 79.0 \right)$$

$$= \left(\frac{17.33}{I_1} - 74.0 \right)$$

$$= \left[\frac{(10.08 \times 36) + (10.08 \times 79.0)}{(10.08 \times 36) + (10.08 \times 79.0)} - 6.98 \right]$$

$$= \left[\frac{(10.08 \times 10.08) + (10.08 \times 79.0)}{(10.08 \times 36) + (10.08 \times 79.0)} - 6.98 \right]$$

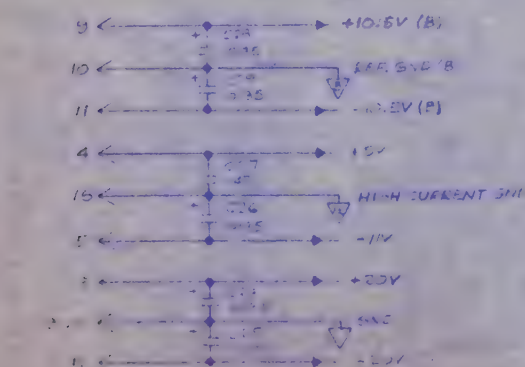
PARTS LIST			
OWN. BY		MATERIAL	MATERIAL
CHECK			STD. & NO.
PR. ENG.		FINISH	
DRAFT. SUPV.			
	WEIGHT	SCALE	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND TOLERANCES ARE		THE SINGER COMPANY	
3X .001	2X .002	PALO ALTO OPERATION	
ANGLES 1"		PALO ALTO, CALIF. 94303	
DO NOT SCALE DWG.		CODE IDENT	SHEET 2 OF 2
		45-0916-001	

PAVIA, 2005 - 13722

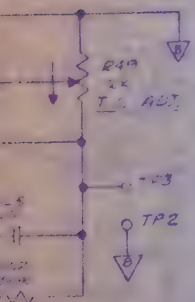
START OF 1922

GROUND FAUNA: CUTS

IMP COMP
AMP FICK



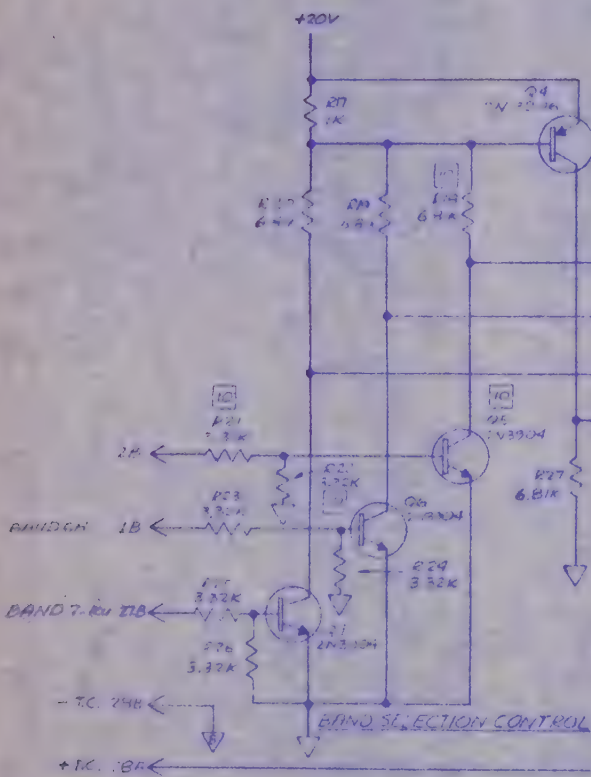
- ☐ INSTALLED IN-004 OPTION ONLY (9515 A, C, G, S, BS)
☐ INSTALLED IN-005 OPTION ONLY (9515 D, E)
☐ INSTALLED IN-006 OPTION ONLY (9515 D3, E3, F3)



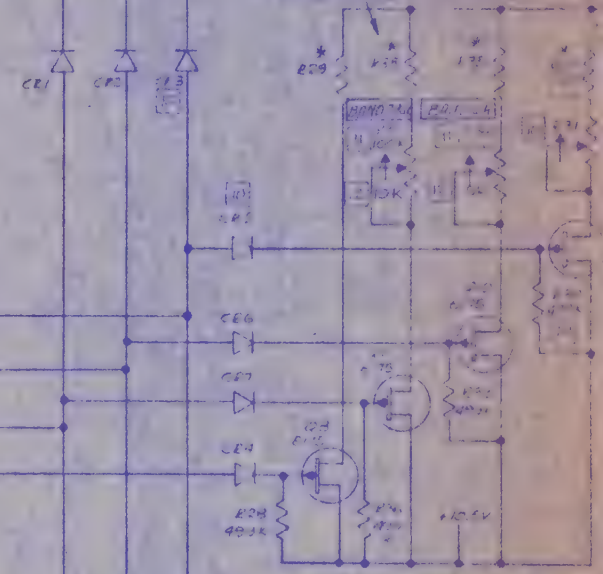
103-310-001		A-15-113	
NEXT ASSY		USED ON	
ALFRED ELECTRONICS			
P.O. BOX 100, ALBANY, N.Y.			
SIZE			Qty
D	100		1
SMALL		OF	

BAND SELECTOR

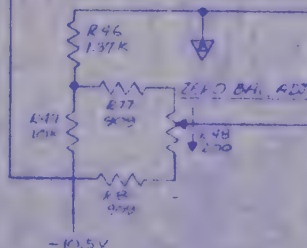
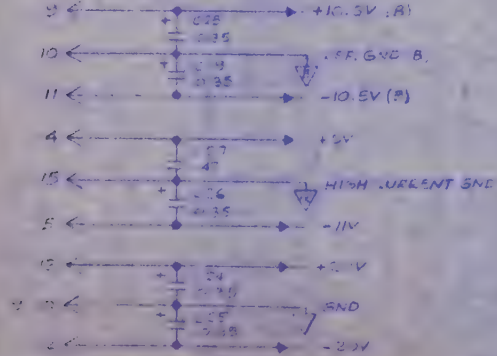
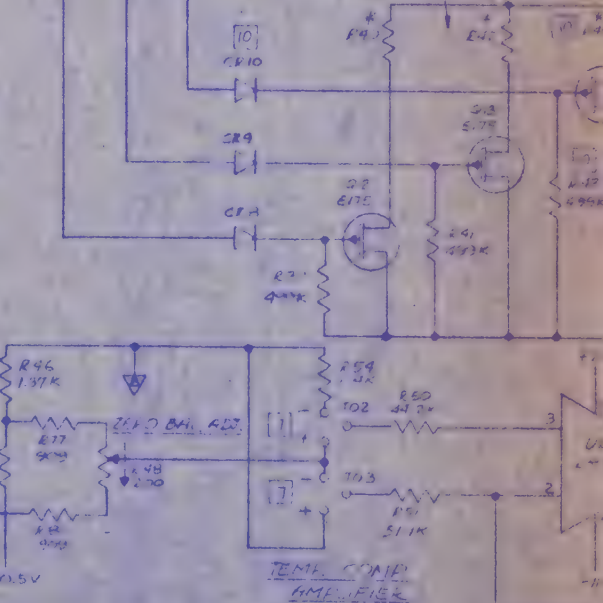
TUNING INPUT 21
0-01



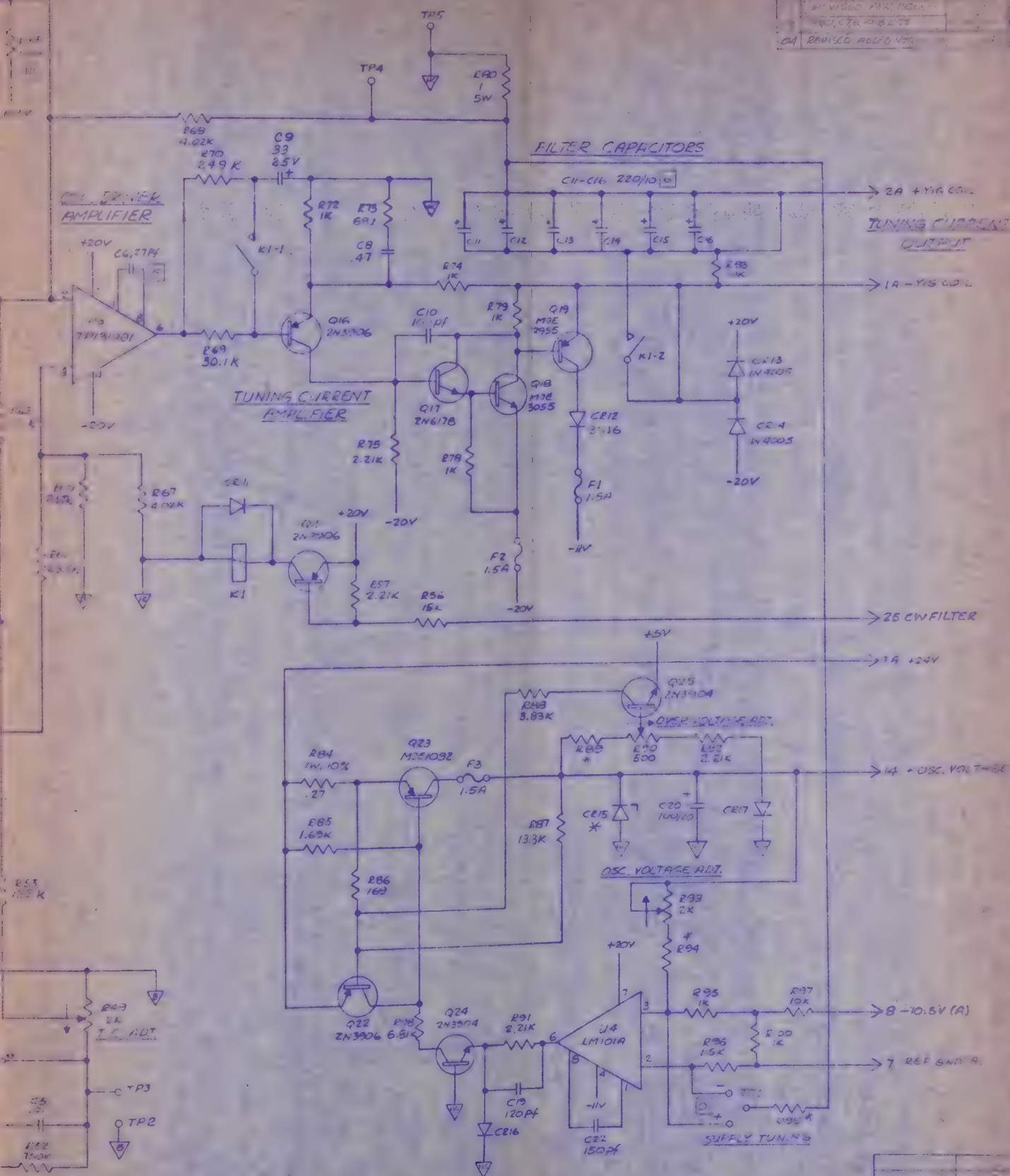
START CONTROL



GROUND BALANCE CRTS.



11 INSTALLED IN -003, OPTION ONLY (951E A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z)
17 " " " " " (9515 D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z)



ITEM		REGO	PART NO	DESCRIPTION	
LIST OF MATERIAL					
MATERIAL			DRAWN	DATE	1. 100% NIP VIG 100% NIP 100% NIP
			CHECK		
			ENG		
MATERIAL STOCK NO			PROD	DIMENSIONS ARE IN INCHES TOL ARE DIA AND DECIMALS N FOR INCHES OTHERWIS	
FINISH OR TREATMENT			SCALE		

NAME		ADDRESS	
CITY		STATE	
NEXT ARMY		INFO. IN	
ARMED ELECTRONICS MAILS TO THE U.S. ARMY			
SUBS. D		MAIL 1	

7515A, B, C, D	7515D	7515E	7515A, B, C, D
$R10 = \left(\frac{11.01}{I_2 - I_1} - 42.7 \right)$	$= \left(\frac{11.57}{I_2 - I_1} - 35.7 \right)$	$= \left(\frac{12.12}{I_2 - I_1} - 35.7 \right)$	$= \left(\frac{11.01}{I_2 - I_1} - 42.7 \right)$
$R13 = \left(\frac{22.51}{I_2 - I_1} - 50.2 \right)$	$= \left(\frac{22.51}{I_2 - I_1} - 43.2 \right)$	$= \left(\frac{22.71}{I_2 - I_1} - 43.2 \right)$	$= \left(\frac{22.51}{I_2 - I_1} - 50.2 \right)$
$R34 = \left(\frac{42.50}{I_1} - 52.3 \right)$	$= \left(\frac{44.65}{105 I_1 + 42.2} - 38.3 \right)$	$= \left(\frac{44.65}{105 I_1 + 42.2} - 38.3 \right)$	$= \left(\frac{42.50}{I_1} - 52.3 \right)$
$R38 = \left[\frac{(R10 + 42.7)(11.01)}{(R10 + 42.7)I_1 - 17.69} - 57.3 \right]$	$= \left[\frac{(R10 + 43.2)(11.57)}{(105)(R10 + 43.2)I_1 - 18.57(42.2)(R13 + 43.2)} - 40.8 \right]$	$= \left[\frac{(R12 + 43.2)(12.12)}{(105)(R12 + 43.2)I_1 - 18.57(42.2)(R13 + 43.2)} - 40.8 \right]$	$= \left[\frac{(R10 + 42.7)(11.01)}{(R10 + 42.7)I_1 - 17.69} - 57.3 \right]$
$R39 = \left[\frac{(R10 + 42.7)(11.01)}{(R10 + 42.7)I_1 - 26.13} - 102.3 \right]$	$= \left[\frac{(R10 + 43.2)(11.57)}{(105)(R10 + 43.2)I_1 - 26.13(42.2)(R13 + 43.2)} - 43.3 \right]$	$= \left[\frac{(R12 + 43.2)(12.12)}{(105)(R12 + 43.2)I_1 - 26.13(42.2)(R13 + 43.2)} - 43.3 \right]$	$= \left[\frac{(R10 + 42.7)(11.01)}{(R10 + 42.7)I_1 - 26.13} - 102.3 \right]$
$R40 = \left[\frac{(R10 + 42.7)(11.01 + 2.1)}{(R10 + 42.7)I_1 + 4.5} - 23.7 \right]$	$= \left[\frac{(R10 + 43.2)(11.57 + 4.3)}{(R10 + 43.2)I_1 + 7.0} - 20.0 \right]$	$= \left[\frac{(R12 + 43.2)(12.12 + 4.3)}{(R12 + 43.2)I_1 + 7.0} - 20.0 \right]$	$= \left[\frac{(R10 + 42.7)(11.01 + 2.1)}{(R10 + 42.7)I_1 + 4.5} - 23.7 \right]$
$R42 = \left[\frac{(R10 + 42.7)(11.01 + 57.3)}{(R10 + 42.7)I_1 + 107.5} - 23.7 \right]$	$= \left[\frac{(R10 + 43.2)(11.57 + 10.8)}{(R10 + 43.2)I_1 + 104.0} - 20.0 \right]$	$= \left[\frac{(R12 + 43.2)(12.12 + 10.8)}{(R12 + 43.2)I_1 + 104.0} - 20.0 \right]$	$= \left[\frac{(R10 + 42.7)(11.01 + 57.3)}{(R10 + 42.7)I_1 + 107.5} - 23.7 \right]$
R34 10	5	5	10
R37 100	10	10	100
R61 23.7	20.0	20.0	23.7
R62 52.3	38.3	38.3	52.3
R64 40.2	33.2	33.2	40.2
R65 12.5	12.5	12.5	12.5
$R89 = \left(\frac{V_{max}}{2} - 3 \right)$	$V_{max} = V_{bias}$		
$R94 = (2V - 1)$	$V = V_{operating}$		
$CR15 = (V_{bias})$	$I_1 = \text{MAGNET CURRENT @ 12.4 GHz}$		
	$I_2 = \text{MAGNET CURRENT @ 18 GHz}$		
			CURRENT IN AMPS RES IN OHMS

	95.5 ES
25.7	$\left(\frac{3.42}{1000} - 25.7 \right)$
3.2	$\left(\frac{4.2}{1000} - 4.2 \right)$
-23.2	$\left(\frac{4.2}{1000} - 38.2 \right)$
-40.8	$\left(\frac{4.2}{1000} - 40.8 \right)$
	$\left(\frac{4.2}{1000} - 23.2 + 42.1(100.57) \right)$
	$\left(\frac{4.2}{1000} - 20.0 \right)$
	$\left(\frac{4.2}{1000} - 20.0 \right)$
	5
	10
	20.0
	38.2
	33.2

PARTS LIST			
DWN. BY		MATERIAL	MATERIAL STOCK NO.
CHECK		FINISH	
PH. ENG.			
DRAFT. SUPV.		WEIGHT	SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND TOLERANCES ARE .015 .005 .01		THE SINGER COMPANY PALO ALTO OPERATION PALO ALTO CALIFORNIA SIZE Dwg. NO. 156-0819-001 SHEET 2 OF 2	
DO NOT SCALE DWG.		CODE IDENT	

Q8 supplies steady voltage to hold the oscillator at the low frequency end of the band. When Q4, Q5, or Q6 conducts, its collector current comes partly from the base of Q4. This turns ON Q4 so that FET Q8 is cut OFF by positive voltage at the gate, and the proper sweep starting voltage is supplied by Q9, Q10, or Q11.

4-96. Ground balancing currents are provided by resistors R40, R42, and R44, which are connected in parallel with R60, via R61, by FET's Q12, Q13, and Q14

4-97. Currents to compensate for temperature changes are provided by U2, which gets temperature data from a temperature sensing resistor, via pin 28A of the PCB connector.

4-98. Currents through the FET's are converted into proper voltages at the output to the oscillator by the operational amplifier U3, impedance changer Q16, Darlington amplifier, Q17 and Q18, an emitter follower, Q19. Current through the YIG tuning coil flows through R60, developing a voltage.

4-99. This negative feedback voltage to pin 2 of U2 goes back through R68.

4-100. Current is fed through R59 from an optional frequency offset signal, R64 from the tuning ramp, R62 from the starting voltage gates, R61 from the ground balance circuits, R63 from the temperature compensation amplifier, and R68 from the feedback voltage.

4-101. If the voltage at pin 2 of U2 is more than about 2 millivolts from ground, pin 6 of U2 will be at one of the supply voltages, +20V or -20V. Feedback through R68 is negative, so voltage at pin 2 is held close to ground, and the sum of all currents to that point must be zero. This means that the voltage at pin 6 is directly proportional to the sum of the currents through R59, R62, R63, and R64, but of opposite polarity.

4-102. FM is provided by the circuits on A2, which deliver current to the FM coils of the YIG tuned oscillators. See paragraph 4- .

4-103. The tuning voltage is filtered by capacitors C11 through C13 when the CW filter signal into pin 25 of the PCB connector goes to ground potential. This draws current from the base of Q15, and the resultant collector current closes the contacts of relay K1. Resistor R83 holds the potential on the capacitors at average potential for the tuning voltage, which normally is fixed rather than a ramp, when the CW filter is turned ON. This reduces sudden surges in the tuning current through the tuning coils, as the contacts of K1 close.

4-104. U4 compares oscillator voltage at pin 14 of the PCB connector with a -10.5 volt reference. Output of U4 is fed through Q24 to the series regulator Q23, which therefore holds output voltage to a value set by R93. Q22 limits current in Q23 if current through R84 is excessive. Q25 compares part of the output voltage, selected by R90, with +5 volts. If the output voltage is excessive, Q25 turns ON Q22 which reduces current in the base of Q23, thereby reducing output current, hence voltage.

TABLE 4-6

NO SWEEP OF RF

Step	Procedure	Result	Next Procedure
1	Monitor input to Connector Board, A5, pin nos. 8, 9, 34 of cable connector	a. No sweeps occur. b. At least one sweep occurs.	a. Check controls on 6600 and/or troubleshoot 6600 for outputs F1, F2, F3. b. Go to Step 2.
2	Monitor output of Connector Board, A5, pins 25B, 33B, of Mother Board Connector.	a. No sweep occurs. b. Sweep is present.	a. Replace summing amplifier, U2, or repair connections to it. b. Go to Step 3.
3	Trace sweep through Driver Board for frequency band involved from pin 21 to pin 1A of Mother Board Connector.	a. Sweep disappears prior to Driver Amplifier U3. b. Sweep is present at inputs of mixing resistors which feed pin 2 of U3, but there is no sweep on pin 6 of U3. c. Sweep is present at output of U3 (U2 of 4 - 8 GHz VCO Driver).	a. Check for improper inputs to pins 2B, 16 and 27B. If proper, go to Step 4. If improper, go to Step 5. b. Replace U3 unless C7 is hsorted. If it is, replace C7. c. Check RF oscillator. For 4 - 8 GHz Driver, check Q12, Q13, Q14, Q15, and Q26, K1. Check for improper CW filter signal into pin 25.
4	Check FET sweep and starting voltage gates. Sweeps and starting voltage should pass through gates when corresponding inputs to 2B, 16, and 27B are positive.	a. No outputs from FET's.	a. Check control signals through input transistors. Replace FET, diode, or control transistor, as required.

TABLE 4-6

NO SWEEP OF RF (CONTINUED)

Step	Procedure	Result	Next Procedure
5	Check for presence of control signals at input to connecting cable from 9514.	- Control signals are present. - Signals are not present.	- Repair cable. - Trace back through logic of 9514, to find stopping point of signal. Be sure switch is operating.

4-105. 9514 CONTROLLER

4-106. The 9514 Controller provides connections between the 6600 and the 9515 for supply voltages, amplitude modulation signals, and tuning voltages (ramps). It also provides band selection signals to the 1915. These signals are derived from pushbutton switches on the 9514 front panel and from binary coded signals received via the 6600.

4-107. The decoding circuits use three types of integrated circuits:

1. Two input NAND gates
2. Four input NAND gates
3. Inverting Amplifiers

4-108. The NAND gates have +5 volt outputs unless all inputs are at +5 volts, or floating. The output, with all +5 volt inputs, is ground. The inverters have +5 volts output for ground input and ground output for +5 volts input, or a floating input.

4-109. Assuming that Remote Band is not enabled, the input to terminal 18 is floating. The output of the inverter is ground. This gives a ground input into each of the eight 4 input decoding NAND gates. Hence the output of each 4 input NAND gate is +5 volts.

4-109. The manual control inverter which follows the Band Enable inverter has a ground input, so its output to each of the eight manual switch gates is +5 volts. If a Band Selector switch is pushed open, the input to its control gate floats, and since the other input is +5 volts from the manual control inverter, the manual control gate output is ground. All other manual control gate outputs are +5 volts, since the switch inputs to them are at ground.

4-110. This makes all of the inputs to the Band Control gates (U7 and U8) +5 volts except for the ground signal from the Manual Control gate for the open switch. Consequently, all output band select signals are at ground except for the signal for the open switch; this output is +5 volts.

4-111. For remote operation, the input to the remote band enable inverter is grounded. The inverter output is +5 volts.

4-112. This voltage is applied to one input of each of the 4 input gates. The manual control inverter has a ground output which is applied to each manual control gate. Hence the output of each manual control gate is +5 volts.

4-113. There are three remote band select inputs, marked A, B, and C, each input goes through an inverter. The output of each band select inverter goes to one input of several 4 input gates. It also goes to the input of an inverter above and to the right of the band select inverter. The output of the second inverter goes to one of the inputs of each of the 4 input gates which is not connected to the corresponding band select inverter output.

4-114. With inputs to A, B, and C all grounded, and with Remote Band Enable grounded, the 4 input gates are driven by +5 volt signals from Remote Band Enable inverter and from each band select inverter. Each second inverter has a ground output. Tracing signals through the 4 input gate for Band 0 has ground on pin 13, ground on pin 12, ground on pin 10, and +5 volts on pin 9. Its output is +5 volts, so both inputs to the Band Control gate for Band 0 are +5 volts. The signal on the Band 0 line is ground, which means not selected.

4-115. Going through the other gate connections, it will be found that each 4 input gate has at least one ground input. Hence its output is positive, and the band selection output is ground.

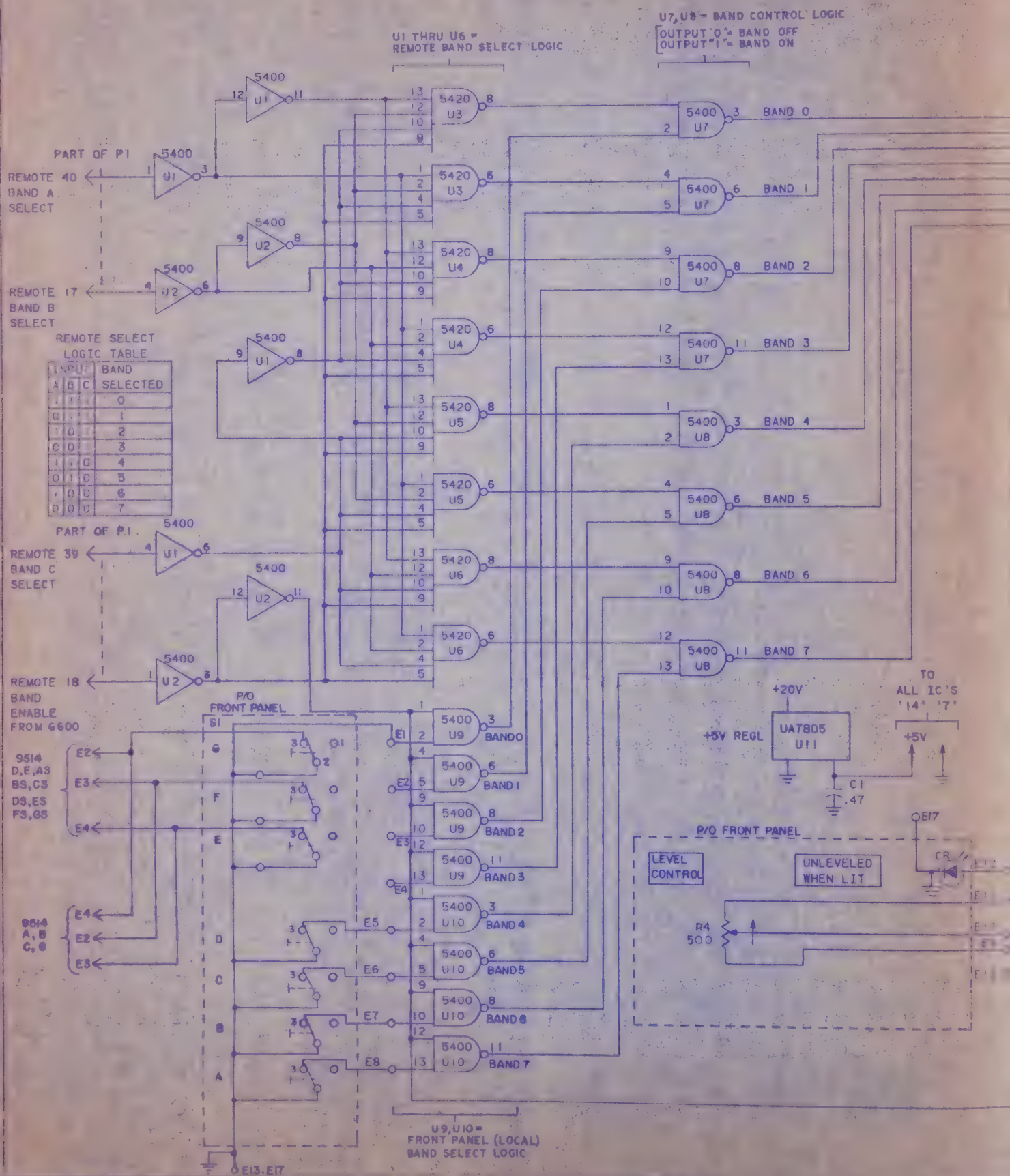
4-116. This is true until Band 7 is reached. For the 4 input gate for Band 7, pin 5 is +5 volts, from the Remote Band Enable inverter. Pin 4 is +5 volts from the Band C inverter. Pin 2 is +5 volts from the Band B inverter. Pin 1 is +5 volts from the Band A inverter. Hence the 4 input gate output is gnd, and the Band 7 output is +5 volts, indicating selection of Band 7.

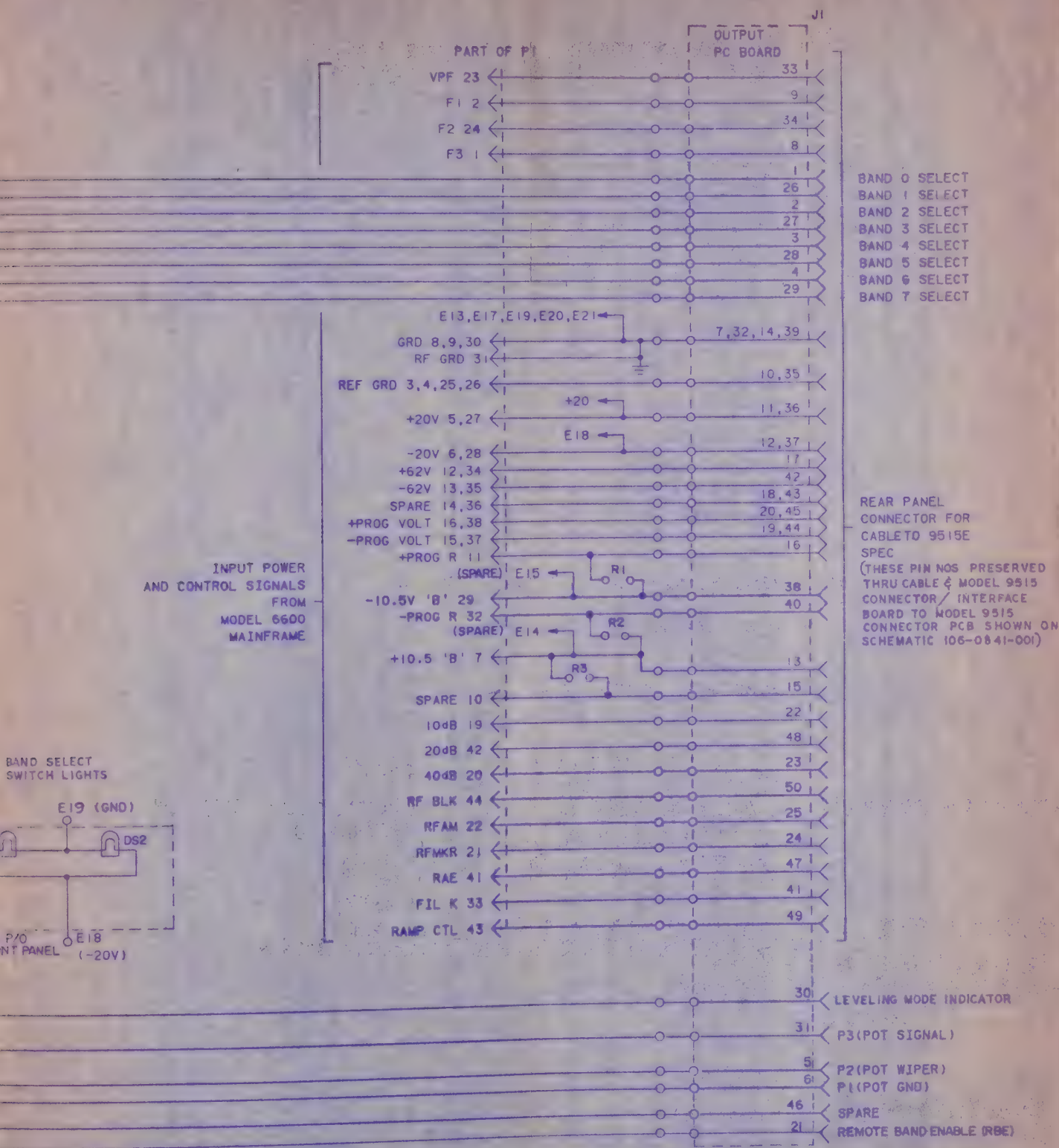
4-117. It will be seen that selection of bands follows the Remote Select Logic Table, where a 1 input means +5 volts, and a 0 input means ground potential.

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL CAPACITORS IN MICROFARADS.

2. "E" TERMINALS ARE ON MAIN PCB. THEY CONNECT TO COMPONENTS NOT ON PCB, AS SHOWN WITHIN DOTTED AREAS.





QTY		ITEM NO.		PART NO.		DESCRIPTION		REF. DES.	
PARTS LIST									
DWN BY				MATERIAL		MATERIAL STOCK NO.			
CHKD				FINISH					
PL' ENG.									
CRAFT. SURV.				WEIGHT		SCALE			
				TITLE					
				UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND TOLERANCES ARE .XX .XXX .XXX .XXX 5.018 & .003 .01"		SCHEMATIC			
-001		952905-08-09		9514D,DS		MODEL 9514 CONTROLLER			
PART NO.		NEXT ASSEMBLY		MODEL		DO NOT SCALE D.W.G.		CODE IDENT	
		FIRST USED ON				SHEET 1 OF 1			
								THE SINGER COMPANY PALO ALTO OPERATION PALO ALTO, CALIF. 94303	
								SIZE DWN NO. GROUP D 106-0812-002	

TABLE 4-7

IMPROPER VPF OUT

Step	Procedure	Result	Next Procedure
1	Check Frequency Control Ramp at pin 25B of Mother Board Connector on Connector A5.	a. Sweep is linear ramp. b. Sweep is not linear ramp.	a. Go to Step 2. b. Check U2 of Board A5 and inputs to Cable Connector pins 8, 9, 34 from 6600. Replace U2 or troubleshoot cable and 6600.
2	Trace Ramp signal from test point 2 through the FET's to inputs to R44 and R52, then output, pin 6, of U3 and output, pin 6, of U4.	a. Ramp loses linearity in FET circuits. b. Ramp is linear at inputs to U3 circuit, but non-linear at output. c. Ramp is linear at U3 output, but non-linear at U4 output.	a. Replace faulty FET or the driving transistor. b. Replace U3, C3, or R45. c. Replace U4, C5, or R50. Check also, R51, C7, and C13, and R48 and R49.

RF OUTPUT IS NOT LEVELED

Step	Procedure	Result	Next Procedure
1	Reduce Power Level setting. It is possible that available power will not reach the desired level.	a. Leveling is proper.	a. Instrument is OK, if power meets specification.
		b. Leveling is still improper.	b. Go to Step 2.
2	Check controls to be sure that the desired leveling sample is selected. Check for polarity of external sample.	a. Controls are OK	a. Go to Step 3.
		b. Controls do not match desired sample.	b. Correct control positions.
3	Trace detected sample from inputs, jacks J1, J2, J3, to PCB A4, through control and amplifier circuits to pin 27A of A4 connector.	a. Signal is not at input jack (100 mV to 200 mV).	a. Check sampler on RF assembly or in external circuit.
		b. Signal comes in but disappears before pin 27A.	b. Check point at which signal disappears. Replace part immediately before that point, in signal path.
		c. Signal at pin 27A is +3.5 to +9.5 volts and varies with RF output.	c. Go to Step 4.
4	Check for proper signals to turn RF ON (ground at pin 6A of A4 connector) and to select Band (+0.5 volts at pin 34B of A4 connector).	a. Selection and RF ON signals are proper.	a. Go to Step 5.
		b. RF is turned OFF or Band is not selected.	b. Trace control signals through A6 and/or 1914. Replace bad parts, to restore signal. If all inputs to U4 are +5 volts, from pins 6B, 13B, 15A, and 22B of A4 connector, and voltage at pin 6A is not ground, replace U4.

TABLE 4-8

RF OUTPUT IS NOT LEVELED (CONTINUED)

Step	Procedure	Result	Next Procedure
5	Trace leveling signal through U12 and Q34 (Ku Band) or equivalents for other bands. Check for Q32 saturated by signal from Q31. Check for shorted transistor, Q33. Trace RF ON signal through Q29, Q30, Q31, and Q32.		a. Replace faulty parts.

TABLE 4-9

AM NOT PROPER

Step	Procedure	Result	Next Procedure
1	Check input signal to pin 6B of A4 connector. Should be +5 volts, to turn RF ON, ground to turn RF OFF.	a. Signal is proper. a	a. Check other inputs to U4, pins 9, 10, 12, 13. If all are +5 volts, pin 8 should be at ground. If not, replace U4. If any of these inputs is at ground, pin 8 should be at +5 volts. If not, replace U4. If U4 is OK, go to Step 2. b. Trace back through 9514, via connector board A5, to 6600. Repair bad connection.
2	Check operation of RF OFF channel, from input to U7 of A4, for band selected, to output, PIN Drive Out.	a. b. Signal is not proper.	a. Replace faulty parts.

4-118. LEVELING CIRCUITS, A4

4-119. The leveling circuits supply driving voltages to the four PIN diode attenuators on the RF assembly. Positive voltages from the leveling circuit outputs, pins 1B, 4B, 13B, and 14B, increase attenuation, to reduce RF output. Negative voltages decrease attenuation to increase RF output. When a band is not selected, the leveling circuit output is approximately ± 4 volts, giving maximum attenuation for that band of RF. When a band is selected, the detected sample of RF which is connected to jack J1, J2, or J3 is used to control the RF output level.

4-120. The detected RF sample is chosen by relays K2 and K3 from the inputs to J1, J2, and J3. The input is amplified between pins 3 and 6 of U1, inverted but not amplified by U2. Relay K1 chooses whether the inverted signal or the non-inverted signal will be used. A negative input signal is inverted by U2. A positive input signal bypasses U2, as chosen by K1.

4-121. The gate of Q4, the Sample and Hold Gate, is driven negative, stopping signal flow when Q10 conducts. Q10 conducts unless pin 6 of U4 is at ground potential. If RF OFF signal at pin 6A of the A4 connector is grounded, Q10 conducts and the detected RF signal is interrupted. This allows capacitor C11 to hold the sampled signal until Q10 is again cut off. Control signals into pins 6B, 13B, 15A, and 22B of the A4 connector are normally ± 5 volts. This places pin 8 of U4 at ground potential. This, in turn, is an RF OFF signal, and the sample signal is interrupted. If RF Blank, Sweep Stop, PM Mod In, or AM Mod In is at ground, pin 8 of U4 is allowed to go positive, and the sample signal may flow through Q4.

4-122. The sampled signal on C11 is isolated from later circuits by Q5 and Q6, without amplification. This puts a very small current drain on C11 so that the voltage is effectively constant for the required holding periods. Amplifier U5 amplifies and inverts the sample signal, combined with the RF level control signal from pin 33A or pin 26B of the A4 connector, via relay K5. The remote level control signal chosen by relay K5 also goes to U6. Relay K___ chooses the sample signal from U5 for leveled operation or the level control signal from U6 for unleveled operation. The chosen signal drives the emitter follower, Q9, which, drives

the four leveling amplifiers.

4-123. Each of the four leveling amplifiers has three inputs: Leveling, from Q9, and RF OFF, from Blanking, Sweep Stop, etc., are common to the four circuits. The third signal is Band select, which allows each RF signal to go to the RF output jack when that band is selected.

4-124. Tracing signals through Ku Band: If Ku Band is not selected, a ground signal appears at pin 13 of U7. Pin 12 of U7 is at +5 volts. Pin 12 of U8 is at ground potential. This causes U12 to have a negative signal at pin 6, which cuts OFF Q34. This allows Q33, a constant current source, to drive the output positive so that the attenuator cuts OFF RF power.

4-125. If RF power is also turned OFF by a positive signal at 6A of the A4 connector, this signal is applied to pin 11 of U7, which drives pin 10 of U7 and the base of Q29 to ground potential. The base of Q30 is at ground potential; Q30 draws approximately 3 mA. This drops the base of Q31 slightly more than 0.5 volts. The emitter of Q31 and the base of Q32 drop the same amount. Hence the emitter of Q32 drops the same amount and draws approximately 22 mA through R123. This drives a maximum of 52 mA through R127 and the PIN diode of the attenuator. If Ku Band is selected by a positive signal into pin 34B of the A4 connector, pin 12 of U8 is allowed to float, and that point rises to approximately 0.9 volts, for no RF sample input, driven by the voltage from Q9 and the voltage divider R118 and R119. This drives pin 6 of U12 more positive, which drives the emitter follower part of the Q34 circuit positive until the emitter is at -9.1 volts and R129 draws 40 mA from -11 volt supply. This is 10 mA more than Q33 supplies, so the output goes negative, and RF is turned ON.

4-126. If RF OFF is at +5 volts, pin 10 of U7 goes to ground, and the +0.9 volts at pin 12 of U8 turns on Q30, so that Q29 is cut off. This causes 5 mA to flow through Q30 and R113. The base and emitter of Q31 drop 0.85 volts. The base and emitter of Q32 drop 0.85 volts, and the emitter draws 40 mA through R123. This current, through the collector of Q32,

exactly equals that drawn by Q34, so the current available to the attenuator circuit is plus 30 mA, from Q33. This cuts off RF power.

4-127. If the signal into pin 11 of U7 is at ground for RF ON, pin 10 is at +1 volt. Since the leveling signal at pin 12 of U8, from Q9, is normally only +0.3 to +0.4 volts, Q30 is cut OFF. This turns Q31 ON and Q32 OFF, so Q32 supplies no current to the attenuator. Output of the leveling circuit depends on the balance of current between Q33 and Q33.

4-128. The sample signal into pin 3 of U12 is amplified by U12 and fed to the base of Q34. A more negative input signal, which represents a stronger RF signal, makes the base of Q34 more negative. This allows the collector to go more positive, which attenuates the RF signal more. This negative feedback effect results in a constant output signal, when leveling is turned ON.

NOTES:

1) DIODES ARE 1N4148 UNLESS DESIGNATED

2) U4, U7, U8: PIN 14 TO +5V

PIN 7 TO GND

3) RESISTORS ARE IN OHMS, MF, $\frac{1}{2}$ W, 1%.

4) CAPACITORS ARE IN MICROFARADS.

5) INSTALL ONLY FOR REMOTE ATTENUATION OPTION (-008 ASSY ONLY)

6) INSTALL FOR <26MHZ OPTION (-002,003&004 ASSY ONLY)

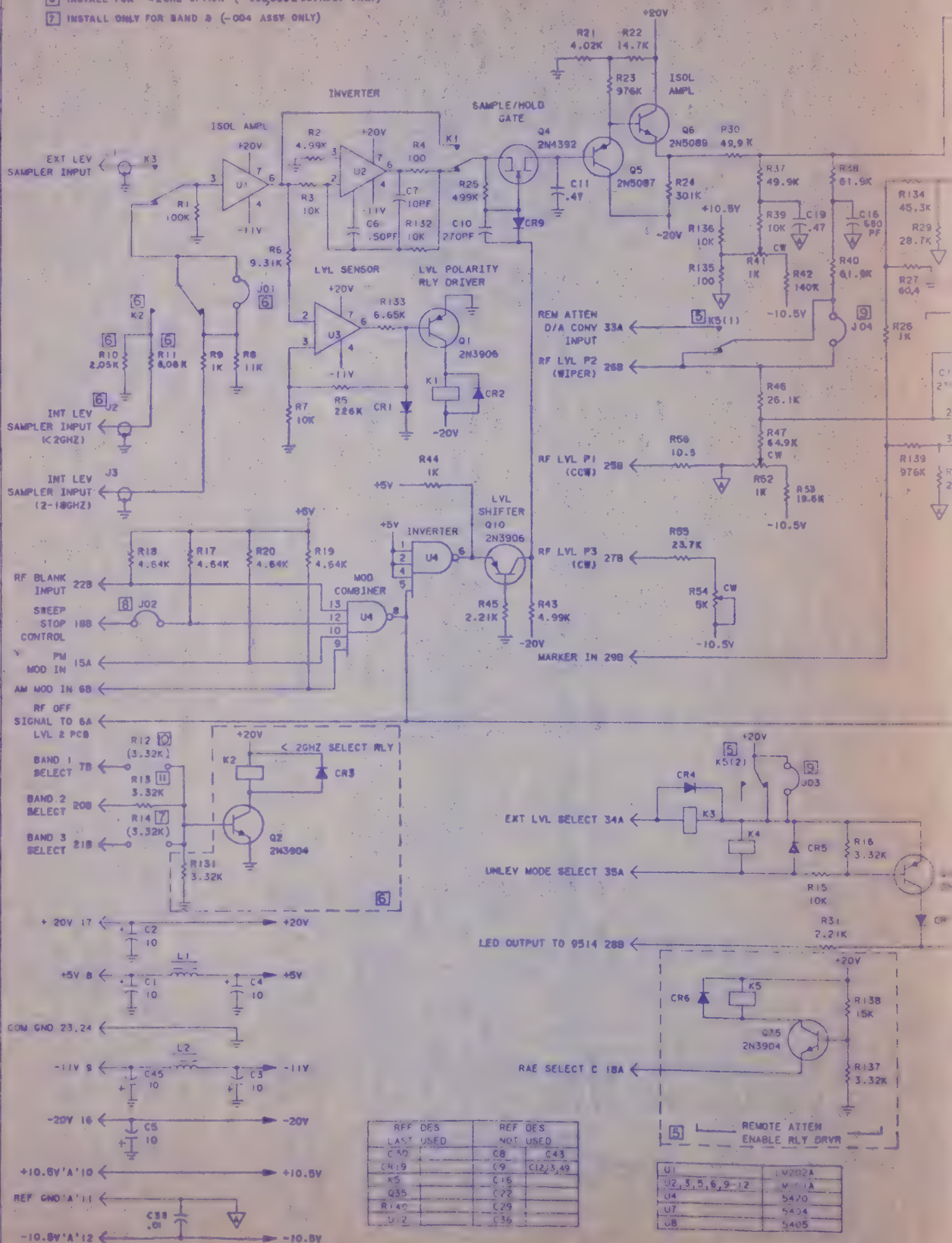
7) INSTALL ONLY FOR BAND 3 (-004 ASSY ONLY)

8) INSTALLED FOR BLANKING DURING SWEEP STOP.

9) INSTALL EXCEPT FOR REMOTE ATTENUATION OPTION (-008 THRU -004 ASSY ONLY)

10) INSTALL ONLY FOR 10-200MHZ OPTION (-003 ASSY ONLY)

11) INSTALL FOR (-002 & -003 ASSY ONLY)



Step	Procedure	Result	Next Procedure
1	Check both RF and Video PM signals. Pulses should have same width as input PM, with rise times no more than 20 nsec longer than input rise times.	a. One signal is OK. Other is not. b. Both signals are bad. c. Neither signal is apparent. Outputs are at +5 volts.	a. Replace integrated circuit U1. b. Go to Step 2. c. Check input to PM gate, pin 36A of A3. Input must be at ground potential to turn PM ON. This places both outputs at ground. If outputs are +5 volts, either PM gate is positive or U1 is bad. d. Go to Step 2.
2	Check for PM signal into J2, PM IN. Signal should be from ground potential, normal, to >+1 volt during pulse.	a. Input pulse is correct. b. Input pulse is not correct.	a. Go to Step 3. b. Correct pulse source.
3	Observe signal at junction of CR2, CR4, and CR5. It should follow input pulse, but limited to +1.5 volts, and -1.2 volts.	a. Output of diode bridge is correct. b. Output of diode bridge is improper.	a. Go to Step 4. b. Check for shorted or open diodes. Drop across bridge from R10 to R11 should be 1.4 volts. If greater, diode is probably open. If less, diode is probably shorted. If zero, expect two diodes, in series, shorted or R10 or R11 open.
4	Trace pulse through CR5, Q1, Q2, and three gates of U1. Emitter of Q1 should approximately follow output of bridge. Collector of Q2 should be at +5 volts during pulse, at ground when input pulse is absent. Outputs at J2 and pin 15 of A3 connector should follow connector of Q2.	a. Pulse distorts or disappears.	a. Replace part which causes pulse to distort or disappears.

4-129. PULSE MODULATION CIRCUIT A3

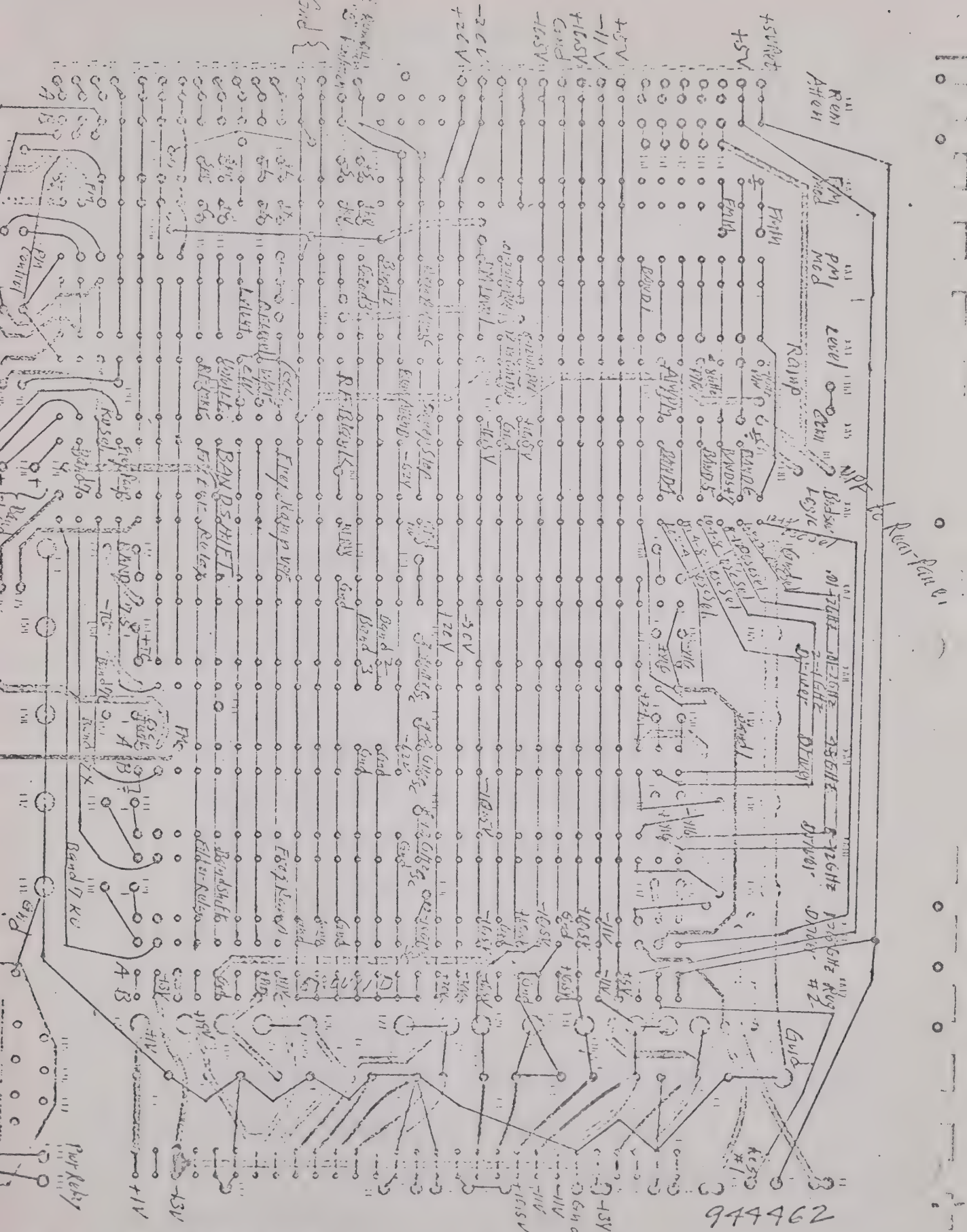
4-130. The Pulse Modulation circuit is a pulse detector plus logic circuit. The input signal into J2 is into a 50 ohm load, R8, R9, and the diode bridge. The diode bridge, CR1, CR2, CR3, and CR4, limits output voltage of the bridge to +1.5 volts for a positive input. This voltage is produced by the current through R10 and CR2, which is approximately 3 mA and the current through R12, which is approximately 2 mA. These combine in R13 to give a voltage of +1.5 volts. There is no current through CR4, since the input signal drives the positive side of R11 above +1.5 volts, via CR3.

4-131. A negative input pulls the negative side of R10 below ground potential via CR1 so that CR2 is cut off. CR3 is also cut off by the negative signal. Current through R12 is approximately 2 mA. Current through R11 and CR4 is approximately 3 mA. Current through CR5 and R14 is approximately 3 mA; hence current through R13 is 4 mA. This makes the voltage into CR5 -1.2 volts.

4-132. With no input signal, the junction of CR1 and CR2 is held to ground potential, so the junction of CR2 and CR3 and CR5 is at ground potential. This puts the base of Q1 at -0.5 volts. The base of Q2 is at +0.3 volts approximately because of currents through R17, R18, R19, and CR6. Q1 is cut OFF for no signal and for a negative signal.

4-133. A positive pulse in, of more than 1.5 volts, puts +1.0 volts on the base of Q1; the emitter follows the base, and Q2 is cut OFF. R16 raises the voltage on pin 12 of U1 to +5 volts. If the PM gate on pin 36A is at +5 volts, the output of pin 13 of U1 is ground, regardless, and pin 4 of U1 is at +5 volts, allowing full amplitude of the RF output. When PM gate is grounded, pin 13 of U1 is at +5 volts and pin 4 of U1 is at ground, cutting OFF the RF output until pin 12 of U1 goes positive, from the PM input. This drives pin 13 of U1 to ground and pin 4 of U1 to +5 volts, turning ON the RF output.

4-134. Pin 1 of U1 has the same output voltage as pin 4, so PM out, at J2, is at +5 volts for the time of each positive pulse, at zero for PM gate grounded (PM ON), and at +5 volts for PM gate open or at +5 volts (PM OFF).



9515 Mother Board - Component side

TABLE 4-11
ALIGNMENT PROCEDURE 9515

1 General

Plug the 9514 connector into the 6600 frame.

Connect the 9514 with the 9515 via the interconnect cable.

Plug the power cords of the 9515 and 6600 into line outlets.

Turn on power switch of the 6600.

At all times, align in the following sequence.

2 Power Supplies Alignment

2-1 Regulator I Alignment, A1

After the unit has been turned on for 15 minutes at room temperature, attach probe of a Digital Voltmeter to point E26 on the Mother Board (+20 V). Connect the ground lead to E21.

Adjust R14 on regulator I board so that the DVM reads $20.000 \text{ volt} \pm .020 \text{ volt}$.

Change probe from E26 to the terminal E27 (-20 volt).

Adjust R26 on regulator board I so that the DVM reads $-20.000 \text{ V} \pm .020 \text{ V}$.

Connect the DVM probe to terminal E23. The DVM should read $+19 \text{ V} \pm .5 \text{ V}$.

Other adjustments on regulator I are not needed. Checks on the voltages will follow after the regulator II alignment.

2-2 Regulator II Alignment, A2

After a warm-up of at least 30 minutes, connect test leads of a DVM between reference ground A (E30) and point E31 (+10.5 V) on the Mother Board.

Adjust R14 on regulator II board so that the DVM reads $+10.500 \pm .005 \text{ V}$.

Change test lead from E31 to E29 (-10.5 V).

TABLE 4-11 (CONTINUED)

Adjust R26 on the regulator II board so that the DVM reads $-10.500 \pm .005 \text{ V}$.

Change test lead from E29 to E24 (- Program Voltage).

With a jumper applied across R30 on regulator II, adjust R31 so that the DVM reads $-3.000 \pm .020 \text{ V}$.

2-3 Verification of Other Supplies on Regulators I and II

Connect DVM between ground terminal E21 and voltage terminal E22. DVM should read $+1.000 \pm .050 \text{ V}$.

Change test lead from E22 to E34. DVM should read $+5 \pm .050 \text{ V}$.

Change test lead from E34 to E32. DVM should read $-11.00 \pm .10 \text{ volt}$.

Change test lead from E32 to E14. DVM should read $+11 \pm .6 \text{ V}$.

Change test lead from E14 to E13. DVM should read $-11 \pm .6 \text{ V}$.

A 9515 with remote attenuation programming is equipped with a floating $+5 \text{ V}$ supply. Check with a DVM between floating ground, point 1 of board A1 (remote attenuation) and point 2 of the same board. The DVM should read $+5 \pm .4 \text{ V}$. This measurement can best be made at the bottom of the 9515.

This concludes the adjustments on regulator I and regulator II boards.

3 Band Control PCB Calibration (A 6)

Set 6600 controls for CW operation, with F_0 set to left end of dial.

Connect low probe of DVM to TP 2, and connect high probe of DVM to slider of R4 (<2 GHz only).

Adjust R4 to obtain DVM reading of $5.025 \pm .010$ volts (<2 GHz only).

Connect high probe of DVM to slider of R12.

Adjust R12 to obtain DVM reading of $3.350 \pm .010$ volts.

Connect high probe of DVM to slider of R20.

Adjust R20 to obtain DVM reading of $5.025 \pm .010$ volts.

Connect high probe of DVM to slider of R28.

Adjust R28 to obtain DVM reading of $4.425 \pm .010$ volts.

Connect high probe of DVM to slider of R36.

Adjust R36 to obtain DVM reading of $1.255 \pm .010$ volts.

Connect high probe of DVM to slider of R44.

Adjust R44 to obtain DVM reading of $3.770 \pm .010$ volts.

Connect high probe of DVM to slider of R52.

Adjust R52 to obtain DVM reading of $6.530 \pm .010$ volts.

4 Leveling Circuit PCB Calibration (A4)

Set 6600 controls for CW operation, with F_0 set to ~ 3 GHz on the 2 - 8 GHz band of the scale.

Set 9514 Controller Plug-in controls as follows: 1) Depress 2 - 8 GHz pushbutton, 2) Set Level Control pot to 9 o'clock position.

On 9515 Oscillator Unit depress UNLEV pushbutton.

Connect power meter to 9515 RF OUT.

Adjust R52 to obtain RF level of $0 \text{ dBm} \pm 0.5 \text{ dB}$ @ 3 GHz.

On 9515 Oscillator Unit depress INT pushbutton.

Adjust R41 to obtain RF level of $0 \text{ dBm} \pm 0.5 \text{ dB}$ @ 3 GHz.

On 9514 Controller Plug-in set LEVEL CONTROL pot fully clockwise.

RF level should read $> +11 \text{ dBm}$.

On 9515 Oscillator Unit depress UNLEV pushbutton.

RF level should read $> +11 \text{ dBm}$.

5 4 - 8 GHz Voltage Controlled Oscillator Alignment

For 9515 Sweep Oscillator units using a varactor tuning oscillator covering the 4 - 8 GHz band, use following alignment procedure. For convenience of alignment, put voltage controlled oscillator driver on an extender board.

5-1 Oscillator Bias Adjustment

1. Connect a DVM hot probe on "+ NC (+15 V)" of the voltage controlled oscillator of 4 - 8 GHz and a cold probe to "GND" of that same oscillator.
2. Adjust R129 on the VCO driver so the DVM reads $15.000 \pm .030$ volts.

5-2 4 - 8 GHz Oscillator Drive Alignment

This alignment is used when the dial accuracy is not within specifications. An oscillator is always accompanied by a matching driver board. If the oscillator needs replacement, its driver board is part of the replacement kit. However, it is possible to align any driver with a new oscillator.

If the linearization of the oscillator is not within specifications or a new oscillator 4 - 8 GHz with matching (VCO) driver is being installed, check first whether the oscillator is linear in the 4 - 8 GHz section of the 4 - 12 GHz band. If this band is within specifications but frequencies are not in specifications in the 4 - 8 GHz section of the 2 - 8 and 2 - 18 GHz bands, only the band alignment should be adjusted.

If the oscillator needs linearization in the 4 - 8 GHz section, perform the following steps:

TABLE 4-11 (CONTINUED)

1. Switch the 6600 Main Frame to the CW mode.
2. Switch the 9514 to the 4 - 12 GHz band.
3. If potentiometer R25 is present, on the driver board, remove temporarily from the board: Q6, R28, R30. If R25 is not present, this entire step can be omitted.

With a digital ohmmeter, measure the resistance from where the drain of Q6 was connected to pin 2 of U2. Adjust R25 so that this resistance is $50K\Omega \pm 1\%$.

Reinstall parts Q6, R28 and R30. This permanently adjusts R25; the procedure need never be repeated.

4. Connect a DVM high probe to test point 3 of the driver and the low probe to test point 4.
5. Connect a microwave frequency counter on the RF output of the 9515.
6. Switch to "leveled" on the 9515.
7. Adjust the RF leveling control on the 9514 to a suitable power level.
8. Make measurements of voltage on the DVM vs. frequency for the range 4.7 - 5.3 GHz.
9. Plot this curve on graph paper. It will be a flat reverse S-curve.
10. Determine on this curve the frequency at which the curvature reverses. Call this the "START" frequency.
11. Adjust the F_o setting on the 6600 so that the indicated frequency corresponds to the frequency at which the curvature reverses. The DVM usually will read $zero \pm 0.1V$.
12. Adjust R40 for a reading of output frequency equal to that set in step 11.
13. Adjust in the sequence R87, R82, R77, R72 by going from this START frequency to 4 GHz so that the frequency counter reading corresponds to the F_o dial reading. R72 adjusts closest to 4 GHz and R87 adjusts approximately 200 - 300 MHz below the START frequency.

TABLE 4-11 (CONTINUED)

14. After the band from 4 GHz to START frequency has been aligned, align the band from START frequency to 8 GHz.

Adjust in the sequence R92, R97, R102, R107, R112 and R117 by going from start frequency to 8 GHz with the F_O dial. R92 adjusts 300 - 400 MHz above the START frequency and R117 adjusts close to or exactly 8 GHz. Match counter readings with F_O settings.

Do not readjust R87, R82, R77, R72 or R40. The location of the adjustment vs. frequency are given in Figure 5-1.

5-3 Band Alignment 2 - 8 GHz

1. Switch in band 2 - 8 GHz on the 9514.
2. Turn F_O to the same START frequency as in step 10 of the 4 - 8 GHz Oscillator Alignment in band 4 - 12 GHz.
3. Adjust R36 to give the same reading on the counter. DVM reads the same as in step 11 of the band 4 - 12 GHz alignment.
4. Make the 4 and 8 GHz dial settings agree with the counter readings by adjusting R23.

5-4 Band Alignment 2 - 18 GHz

5. Switch in band 2 - 18 GHz and adjust F_O to the START frequency, as in step 2.
6. Make the reading on the counter agree with the F_O setting by adjusting R44. DVM reads now the same as step 3.
7. Make the F_O settings at 4 and 8 GHz agree with the counter readings by adjusting R27.

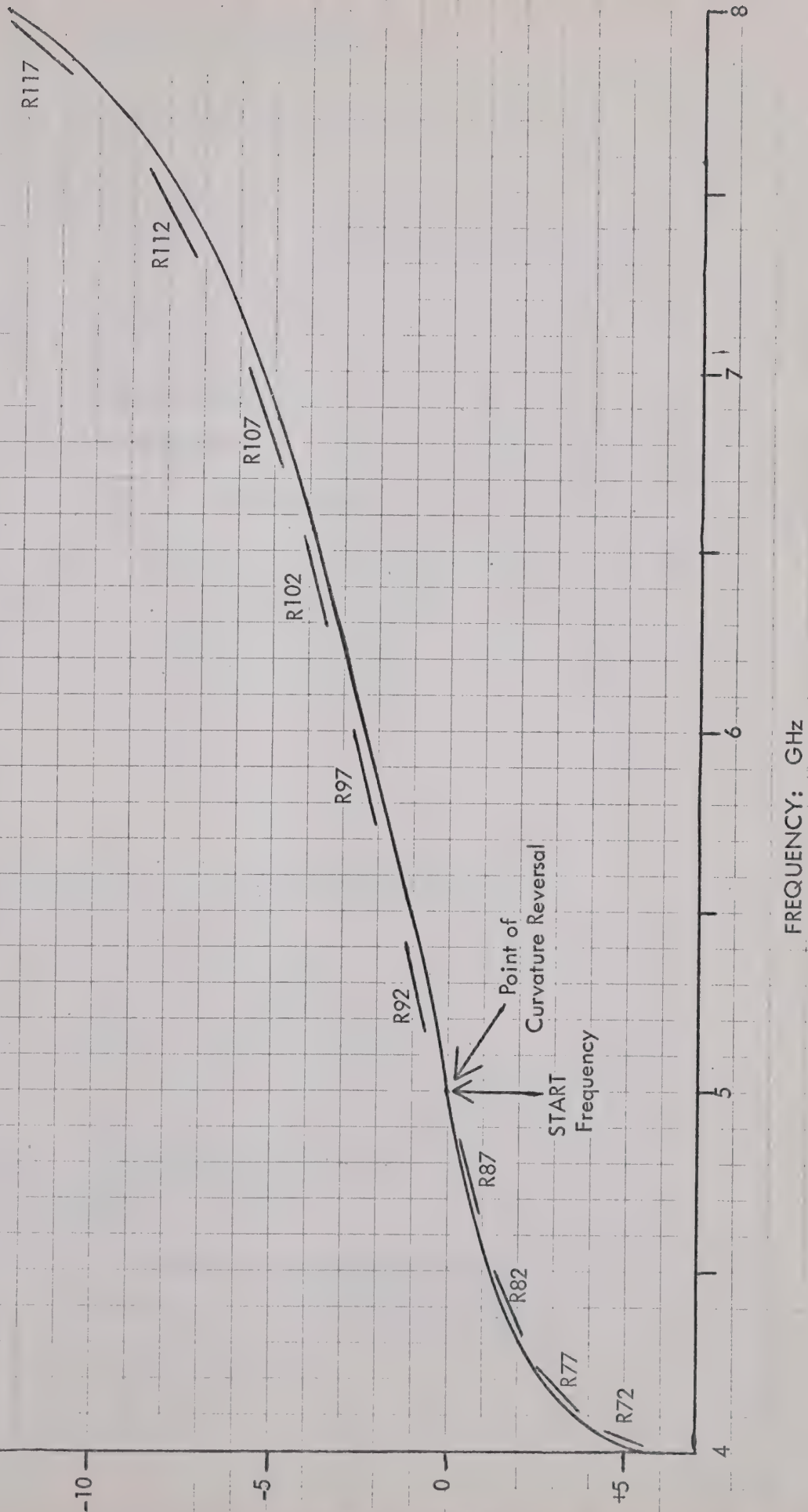
FIGURE 5-1

TYPICAL TUNING CURVE

4 - 8 GHz VTO

Model 9515 Plug-in Unit

DVM Reading @ TP3: Volts



6 ALIGNMENT OF YIG OSCILLATOR DRIVERS

6-1 General

YIG tuned oscillator drivers in the 2 - 18 GHz band need three different alignments:

1. Oscillator voltage adjustments.
2. Temperature compensation adjustments.
3. Frequency band adjustments. If a driver needs an adjustment because the frequency is slightly out of specification, this alignment is referred to as Short Frequency Alignment Procedure (Paragraph 5-6-2). However, if a new driver board has to be aligned to an oscillator, the Master Driver Alignment Procedure is required (Paragraph).

6-2 2 - 4 GHz YIG Driver Short Frequency Alignment Procedure

1. Switch the 6600 to the F_O mode.
2. Switch the 9514 to the 2 - 8 GHz band.
3. Switch the 9515 to the Internal leveled mode.
4. Adjust the RF level control on the 9514 for a convenient RF power level.
5. Put the 2 - 4 GHz driver on an extender board.
6. Turn power on and wait 15 minutes.

6-2-1 Power Supply Alignment

1. Connect a DVM low probe to E15 (ground) of the Mother Board.
2. Connect the DVM high probe to pin 14 of the driver board.
3. Attach a jumper across resistor R97.

TABLE 4-11 (CONTINUED)

4. Adjust overvoltage protection adjustment R90 for a reading of $+20.7 \pm .2$ volt.
5. Remove jumper across R97.
6. Adjust R93 for a reading of $+20.000 \pm .020$ V on the DVM.
7. Disconnect both probes of the DVM.

6-2-2

Temperature Compensation

1. The adjustments R48 and R49 have been adjusted at the factory. They do not need an adjustment unless the driver board or oscillator has been replaced.
In that case, go to the 2 - 4 GHz Main Alignment Procedure (Paragraph 5-5).
2. To determine whether adjustment is required, connect DVM hot probe on test point 3 and cold probe on pin 10 of driver board. After 30 minutes warm up from room temperature, the DVM should read less than $\pm .3$ V. If not, adjust R48 to give 0 volts, and proceed with the Short Frequency Alignment Procedure.

6-2-3

Frequency Alignment

1. Connect a frequency counter to the RF output connector.
2. Adjust the F_o dial setting of the 6600 Main Frame to 2 GHz - (Band selector switch on 9514 is still on 2 - 8 GHz band).

NOTE: Always approach an F_o setting from the left of the desired setting if possible, to eliminate the hysteresis of a YIG tuned oscillator.
3. Adjust R31 for a reading of 2 GHz on the counter ($\pm .5\%$).
4. Tune F_o on the 6600 to the 3.9 GHz position. Adjust R15 for a reading of $3.9 \text{ GHz} \pm .5\%$ on the counter.
5. Switch to the 2 - 18 GHz band on the 9514.
6. Tune F_o to 2 GHz on the 6600.

TABLE 4-11 (CONTINUED)

7. Adjust R38 for a reading of 2 GHz $\pm$.5% on the counter.
8. Tune F_o to 3.9 GHz.
9. Adjust R9 for a reading of 3.9 GHz $\pm$.5% on the counter.
10. This concludes the frequency alignment of the 2 - 4 GHz YIG oscillator.

NOTE

This instrument does not use a 4 - 8 GHz YIG Oscillator. For alignment of the 4 - 8 GHz band, refer to Step 5.

TABLE 4-11 (CONTINUED)

6-3 Short Alignment 8 - 12.4 GHz Oscillator

1. Put the 8 - 12 GHz driver on an Extender.
2. Connect a DVM low probe to E15 (ground) of the Mother Board.
3. Connect the DVM high probe to pin 14 of the 8 - 12 GHz driver board.
4. Pull out the fuses F1 and F2 on the driver.
5. Disconnect the wire to "+V_b" on the 8 - 12.4 GHz oscillator to eliminate burn-out of oscillator.
6. Put a jumper across R97 of the driver.
7. Adjust "overvoltage" adjustment R90 to read .2 volt less than the maximum allowable supply voltage, as specified by oscillator manufacturer, 18V for Serial Number 26. Set voltage at 17.8V.
8. Remove jumper across R97 and solder connection to +V_b.
9. Adjust R93 for a reading of $V_b = +17.5 \pm .02V$ as specified by the oscillator manufacturer (wait 15 minutes after turn-on).
10. Put fuses F1 and F2 back in place.
11. Install the driver board in its socket without extender board.

6-3-1 Short Frequency Alignment 8 - 12.4 GHz Driver

1. Switch 9514 to 8 - 18 GHz band.
2. Tune F_O to 8 GHz.
3. Adjust R31 for a reading of 8 GHz on the counter. (approach from left)
4. Tune F_O to 12.2 GHz (approach from the left).
5. Adjust R15 for a reading of 12.2 GHz on the counter
6. Repeat steps 4 and 5.
7. Switch 9514 to the 4 - 12 GHz band.
8. Tune F_O to 8.2 GHz (approach from low end).
9. Adjust R34 for a reading of 8.2 GHz on the counter.
10. Tune F_O to 12 GHz (approach from low end).
11. Adjust R12 for a reading of 12 GHz on the counter.
12. As adjustments R12 and R34 interact, repeat steps 8 through 11 several times until frequency readings are within .5% of F_O settings.
13. Switch 9514 to the 2 - 18 GHz band.
14. Tune F_O to 8.2 GHz (tune from the low end).
15. Adjust R38 for a reading of 8.2 GHz on the counter.
16. Tune F_O to 12.2 GHz (from the low end).
17. Adjust R9 for a reading of 12.2 GHz on the counter.
18. As adjustments R9 - R38 interact, repeat steps 14 through 17 several times until frequency readings are within .5% of F_O settings.
19. This concludes the 8 - 12.4 GHz band short frequency alignment.

6-4 Short Alignment of 12.4 - 18 GHz YIG Oscillator6-4-1 Short Temperature Compensation Alignment

The temperature compensation adjustments R48 and R49 have been adjusted at the factory. They do not need an adjustment unless the driver board or oscillator has been replaced. In that case, refer to 12.4 - 18 GHz Main Alignment Procedure.

To determine whether adjustment is required, connect DVM high probe to test point 3 and the low probe to pin 10 of the driver board. The DVM reading should be less than $\pm .3$ V 30 minutes after turn-on at room temperature. If not, adjust R48 for a reading of 0 volt and go to the Short Frequency Adjustment Procedure.

6-4-2 Power Supply Alignment

1. Switch the 6600 to the CW mode.
2. Switch the 9514 to the 8 - 18 GHz band.
3. Switch the 9515 to the Internal leveled mode.
4. Adjust the RF level control on the 9514 for a convenient RF power level.
5. Connect a microwave frequency counter at the RF output of the 9515.
6. Put the driver board on an extender.
7. Pull out fuses F1 and F2.
8. Disconnect the wire to $+V_b$ on the oscillator with a solder iron.
9. Connect a jumper across R97.
10. Connect a DVM high probe to pin 14 of the driver board and the low probe to terminal E15 of the Mother Board.
11. Turn the unit on and adjust with R90 so the DVM reads .3 volt less positive (or negative) than the maximum allowable V_b voltage as specified by the oscillator manufacturer. For S/N 26 (V_b) this is $+14 - .3 = +13.7$ volt.

12. Turn unit OFF.
13. Remove DVM high probe and the jumper across R97.
14. Put fuses F1 and F2 back in place.
15. Remove board extender and insert driver board in its socket.
16. Put DVM high probe on pin 14 of the 12 - 18 GHz driver at the bottom of the Mother Board.
17. Solder wire V_b to the oscillator in place again.
18. Turn unit on and wait 15 minutes.
19. Tune F_o for a reading of 18 GHz on the frequency counter. If the driver does not make it to 18 GHz, adjust R12 and/or R34.
20. Adjust R93 for a DVM reading of $10.750\text{ V} \pm .020\text{ V}$, for Serial Number 26.

6-4-3 Short Frequency Alignment

21. Band setting on 9514 is still in 8 - 18 GHz position.
22. Tune F_o to 12.6 GHz (approach from the low end).
23. Adjust with R34 for a reading of 12.6 GHz or as close to this frequency as possible on the frequency counter.
24. Tune F_o to 18 GHz.
25. Adjust R12 for a reading of 18 GHz on the counter.
26. As the adjustments of R12 and R34 interact repeat steps 22 - 25 until frequency readings are within .5% of F_o settings.
27. Tune F_o to 12.4 GHz, approaching from the right. The reading of the DVM should be within .050V, of the value shown on the enclosed oscillator specifications.

TABLE 4-11 (CONTINUED)

28. Repeat step 20 and compare readings of step 20 and step 27. Average out the two DVM readings until step 20 and 27 are within specification.
29. Remove DVM.
30. Switch to band 2 - 18 GHz on the 9514.
31. Tune F_o to 12.6 GHz (approach from low end).
32. Adjust R37 for a reading of 12.6 GHz on the counter (or as close as possible to that frequency).
33. Tune F_o to 18 GHz.
34. Adjust R9 for a reading of 18 GHz on the counter.
35. As adjustments R9 and R37 interact, repeat steps 31 - 34 until the frequency readings are within .5% of F_o settings.
36. This concludes the Short Frequency Alignment Procedure.

WARNING

Protection circuitry in the 9515 provides a folding-back voltage to protect against unusually high line transients. If this mechanism operates, the instrument can be returned to operation by switching the power switch off and on again.

4-135. RETURNING THE INSTRUMENT

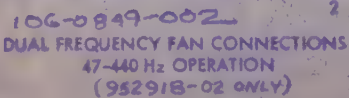
4-136. If it is necessary to return the instrument to SINGER INSTRUMENTATION, authorization must first be obtained from our Customer Service Department. When authorization is received, prepare the instrument for shipment. A protective shipping plate or a piece of cardboard should be placed over the frequency scale area for protection. Place a board or heavy cardboard buffer in front of the panel to protect it from blows against the container.

4-137. Wrap the instrument in a protective material such as polyethylene and heavy wrapping paper. Place a sufficient quantity of padding material, such as hair flex, all around the instrument for cushioning. If the original shipping container is not available, use an equivalent rugged cardboard container or wooden crate. Pack the instrument so that it cannot move around in the container. Send a letter containing all pertinent information in the package, unless such a letter has previously been sent to our Customer Service Department.



ITEM	REQD	PART NO	LIST OF MATERIAL	
MATERIAL _____			DRAWN	DATE 1/29/70
			CHECK	
			ENG	
			PROD	
			SCALE	
MATERIAL WITH A NO			FINISH OR TREATMENT	
SEE THE DRAWINGS FOR THE PART DETAIL				

103-3122-001		
NEXT ASKY		USED ON
ALFRED ELECTRONICS PALO ALTO, CALIFORNIA		
SIZE		REV
D	103-3122-001	
WIDE		OFF



-001	25075
PART NO.	NIGHT ASSEMBLY
	FIRST USED



QTY -001	ITEM NO.	PART NO.	DESCRIPTION	REF DES
PARTS LIST				
		MATERIAL	MATERIAL STOCK NO.	
		FINISH		
		WEIGHT	SCALE	
TITLE	POWER SUPPLY A14, SCHEMATIC DIAGRAM		THE SINGER COMPANY PALO ALTO OPERATION PALO ALTO, CALIFORNIA	
			SIZE DWG. NO.	ISSUE
			C 106-0849	01
WG.	CODE IDENT	SHEET / OF /		

SHIPMENT DAMAGE CLAIM

The instrument should be tested as soon as it is received. If it fails to operate properly or is damaged in any way, a claim must be filed with the carrier. Have carrier agent inspect damage to instrument and packing crate and forward us a copy of his written report. You will then be advised of replacement or repair arrangements and disposition of the equipment. Please include model number, type number and serial number when referring to this instrument for any reason.

REPACKING FOR SHIPMENT

The instrument should be packed in the original carton. If unusable or not available, use a wooden box with approximately three inches of excelsior or other shock-absorbing material surrounding the instrument. If desired, packing services of a local transfer and storage company may be employed.

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